DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Edited by EDWARD LIVEING, B.A.
Scientific Adviser: A. S. RUSSELL, D.Sc.

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LIST OF CONTRIBUTORS

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Editorial Notes

WITH this number our journal enters upon its third year. The fact that it has survived the lapse of two difficult years, in which many sections of our community have found it necessary to abandon magazine-buying as an unpermissible luxury, and has found a wide and permanent reading-public, speaks for itself. There is obviously room for a magazine that attempts to keep abreast of contemporary developments and discoveries in the ever-increasing spheres of human activity and intellectual endeavour. In these the year 1921 has, indeed, been very rich.

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Apart from advances in scientific knowledge, an event occurred towards the end of last year which is likely so to affect the year 1922 and, in fact, the whole of the twentieth century, that we cannot afford to disregard it in our pages. This was the opening of the Disarmament Conference at Washington. Whether this conference succeeds or fails, it will have expressed in a very forcible way the tendencies in international desires matured by the late war. If it fails or only succeeds partially, its expression of an intense popular feeling will have a marked influence on the thought and activities not only of our generation, but of many subsequent ones. If it succeeds, and an honest collaboration in following the paths of peace ensues, the spirit of internationalism will grow apace, and a great flood of human energy and financial resources will gradually be diverted from destructive into constructive channels. Of vast importance, too, to our own Empire is the agreement between the United Kingdom and Ireland. Both events should greatly assist in re-establishing our prosperity and, what comes particularly near to the hearts of the readers and writers of DISCOVERY, in ushering in a year of renewed progress in the arts and sciences, and their application to life.

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From the amount of correspondence that reached the Editor's table as the result of Professor Douglas Knoop's article in our November number, it is obvious how great a diversity of thought has been roused by the problem of unemployment. While keeping our correspondence column open to all shades of opinion on the question, we do not intend to pronounce any judgment on it in these notes. At the same time, we cannot refrain from calling our readers' attention to the extremely interesting and largely successful methods that are being employed to combat the difficulty in Germany. The most important feature of the complicated system, which Germany has put into force, is that of the *Umschulung*. A detailed description of it appeared in *The Nation and the Athenæum* on November 5 of last year. We have not space to do more than outline it here.

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The *Umschulung*—the industrial training of adults—was instituted by a decree of the *Reichsarbeitsministerium* of April 9, 1920. Though it has had to be both modified and amplified by various circumstances, its general methods have remained the same. Its purpose in the main is to transfer workers from overcrowded or obsolescent industries to those in need of employees, and at the same time to supply the necessary financial assistance to employers and employed during the period of transfer. So far as the individual worker is concerned, it guarantees to train any worker of good character, who has been thrown out of employment through no fault of his own, in a trade in which workers are in greater demand. The training allowance,

of which one-sixth of the cost is borne by the municipality, two-sixths by the State, and three-sixths by the *Reich*, is paid to the business concern in which he is apprenticed for the purpose of learning his new trade. The concern has to pay him a fixed sum, usually two-thirds of the trade union standard wage, so long as he is below the average in proficiency at his trade, however unproductive he may remain during the first weeks. At first sight it would appear that all kinds of disadvantages would accrue to both employers and employed, but the whole scheme is too carefully supervised by Training Committees composed equally of employers and trade union representatives, by the Works Councils and by the local employment exchanges, to admit such possibilities. Nearly all workers remain in the concerns to which they were originally apprenticed under the scheme.

Apart from individual cases, training on a *wholesale* scale for new projects is carried out on these lines. This is only one of a number of measures for relieving unemployment. Its purely practical advantages over the dole system are obvious; it puts the taxpayers' and ratepayers' money to a profitable use; it provides the unemployed workers with the knowledge of a craft, and in many cases of an extra craft; it keeps a full store of skilled men against a sudden boom in trade.

Contributors to this Number

Mr. E. N. Fallaize is the Hon. Secretary of the Royal Anthropological Institute. Amongst many other activities in the sphere of anthropological research, he has acted as the Recorder of the Anthropology Section of the British Association since 1906, and has contributed extensively to the literature of his science. During the war he served with the infantry in the Salonica forces. At the Bulgarian Armistice he was on the Intelligence Staff at G.H.Q. in Salonica, and after its conclusion proceeded to Constantinople.

Mr. J. U. Powell is the Senior Tutor of St. John Baptist College, Oxford University. A long period of research in Greek history and literature of the fourth and immediately subsequent centuries B.C. has led to his editing in company with Mr. E. A. Barber, and largely writing, *New Chapters in the History of Greek Literature*, published in the autumn of last year.

Professor F. E. Weiss is the Harrison Professor of Botany at Manchester University. Amongst the many important positions which he has held at that University has been that of the Vice-Chancellorship, 1913–15. He is fond of the practical side of gardening, and is a mountain-climber.

Mr. F. A. Hampton was appointed a Lecturer in Physiology at Oxford University in 1914. He was unable to take up his duties owing to the outbreak of war, during which he served from 1914 to the Armistice on the Western Front as medical officer in various cavalry, infantry and air force units, gaining the Military Cross. His first-hand knowledge of the effects of fighting on the nervous system was employed after the Armistice at one of our largest hospitals for the treatment of shell-shock. He is now engaged in the treatment of nervous diseases.

Mr. Arthur Bowes acted for many years as municipal engineer to the local authorities of Salford and Newton-in-Makerfield. In 1891 he was elected an Associate Member of the Institution of Civil Engineers. He has written widely on engineering and architectural subjects, and recently on lighter subjects of a literary nature.

Mr. Rowlands Coldicott, who concludes his notes on Dr. Wolcot, spent several years of research on his subject at Durham and Oxford Universities before the war. During the war he served with the infantry in France, Salonica, and Palestine. In the advance to Jerusalem he gained the Military Cross, was shot through the lungs a few weeks later on the Mount of Olives, but made a miraculous recovery. At the Armistice he was acting as Education Officer to the cavalry in Belgium. His war book, *London Men in Palestine*, attained a deserved success.

The Rhodesian Skull and the Antiquity of Man

By E. N. Fallaize

Hon. Secretary, Royal Anthropological Institute

Considerable interest has been aroused by the announcement made early in November that a human skull of extremely primitive type had been discovered in fhe Broken Hill Mine in Northern Rhodesia. This skull has now been presented to the Natural History Museum, South Kensington, and has been exhibited by Dr. A. Smith Woodward at a meeting of the Zoological Society held on November 23. Although when exhibited it had not been subjected to that detailed measurement which will be necessary before it can be compared exactly with other types of skulls, it is still possible to indicate its more salient characteristics and to suggest tentatively certain conclusions as to its place in the scale of human development. At the same time, a word of caution is necessary. Past experience has shown that too much insistence cannot be laid upon the conditions of the discovery, and in this case such warning is especially necessary in view of the currency which has been given to claims for a high antiquity for this skull without adequate mention of the qualifications to which those claims are subject. A brief recapitulation of the facts will, therefore, not be out of place.

The skull was found at the end of a cave which was being excavated for sulphates of zinc and lead. The floor of the cave was composed of fossilised bones of mammals, both large and small, including the remains of elephants, leopards, rhinoceroses, hippopotami, lions, antelopes, etc., and also birds and bats. Of these, there were indications that some had formed the food of hyenas and of man. The skull was found after the removal of some hundreds of tons of these bones. When its possible importance was realised, a further search was made and other human remains were found, including part of a jaw, part of a sacrum or hip-bone, and parts of the long bones (both femur and tibia). The

remains were found at a depth of 60 feet below water level, and 90 feet below ground level. In this connection two points are worthy of note. In the first place, the summit of the kopje, which originally covered the site before mining operations were begun, showed, at its highest point, signs of a subsidence in the shape of a shallow depression; and secondly, over the human remains was a fissure which at some time had communicated with the surface.

The skull is in a remarkably good state of preservation, and very fresh in appearance. It is complete and is only very slightly mineralised; this, in view of the condition of the mammalian remains with which it was associated, is in itself a remarkable fact. Its more primitive characteristics are at once evident to the observer. These are the extreme prominence of the eyebrow ridges and their marked lateral extension, the projection of the lower part of the face, and the length of the face as compared with that of the modern type of skull. Owing to the projection of the eyebrow ridges, the upper part of the skull has an ape-like appearance of flatness. The whole character of the face, in fact, is remarkably ape-like and, as Professor Elliot Smith has suggested, when clothed with flesh it was probably even nearer to the facial aspect of the gorilla owing to the splaying of the flat nostrils. Another ape-like character was a great thickening of the muscles of the neck as indicated by the deep impressions at the base of the skull.

On the other hand, Dr. Smith Woodward, in describing the skull, called attention to certain features in which it displays the characteristics of modern man. The brain case is modern in type and its thickness is not greater than in modern man. Its capacity, so far as can be judged without accurate measurement, is well above the lower level of the modern type. The upper jaw is perfectly human; the skull has a well-domed palate and the teeth are human and not simian. The jaw is of remarkable size. Unfortunately, the lower jaw is missing, but, as Dr. Smith Woodward has demonstrated by means of a model, even the massive Heidelberg jaw is not large enough to fit the upper jaw of this skull. In another respect this skull is strikingly modern. The *foramen magnum*, the aperture by which the spinal cord enters the skull, is centrally situated, whereas in the apes and in primitive types of skulls it is situated nearer to the back of the skull, giving the head a forward carriage. Rhodesian man's head was balanced in a perfectly upright position on the trunk.

The teeth are in an extremely bad condition. Not only are they very much worn, as in all primitive skulls, but in addition to the traces of abscesses, caries is present in the teeth themselves. This is a condition not hitherto found in any primitive skull, the earliest cases previously known having been found in Egypt and dating from the time of the Pyramids.

The long bones are also modern in character and indicate that the individual to whom they belonged was tall and walked upright, while Professor Elliot Smith is of the opinion that the fragment of the sacrum indicates the female sex.

From this brief description of the salient features of the Rhodesian skull, it is evident that it presents certain very remarkable and contradictory characteristics. It

SKULL OF THE RHODESIAN MAN.

appears to combine ape-like and modern elements in a manner and a degree exhibited by no other known skull. In this respect alone it bids fair to provide material for controversy for some time to come. For the adequate discussion of these problems, however, more accurate examination at the hands of the expert must be awaited. At present the chief interest of the discovery lies in the light which, at first sight, it appears likely to throw upon the antiquity and evolution of man. Yet at the moment, as has already been said, any suggestion must be taken as tentative and as indicative of the points to which investigation should be directed, rather than as providing any definite advance towards a solution of these problems.

In order to understand clearly the bearing of an inquiry into the antiquity of any particular find of human remains, it should be borne in mind that the evidence of age may be drawn from one or more of several sources. The evidence may be geological, the geological stratum in which the remains are found

belonging to some horizon to which the geologist is able to assign a more or less definite date ; or, when animal remains are associated with the human remains, the palæontologist may be called in to state whether the remains belong to an existing or extinct species, and if the latter, to what date or geological epoch they may be referred, as, for instance, in the case of the mammoth, the cave bear, and the like. Again, the evidence may be purely archæological ; with the human remains may be grave furniture, pottery, or other articles of human manufacture, known from other sources to belong to a certain period, era, or age. Finally, there is the class of evidence afforded by the morphology of the remains, whether used in conjunction with other evidence or, as sometimes happens, as the only available source of information : the anthropologist, by careful examination and measurement, is able to refer them to a known type, or, as in such a case as the present, to suggest a relation to a known type. This relation may be either a relation in time—that is, a stage in evolution—or simply a place in a logical scheme of classification.

In view of the fact that it has been suggested that the Rhodesian skull may date back to even a hundred thousand years, it is particularly important that the nature of the evidence requisite to the support of such a claim should be clearly understood. It may be said at once that in so far as the information at present available goes, of the four classes of evidence enumerated, three furnish no assistance towards deciding the question of the antiquity of the Rhodesian skull. A similar find in Europe might be assigned to a datable epoch, such as the Pleistocene to which Palæolithic man in Europe belongs. Our knowledge of recent geology in South Africa does not warrant a correlation with the Pleistocene in Europe. Further, the existence of the fissure in the cave, to which reference has been made, opens the way to a suggestion that the remains may have been deposited comparatively recently in the position in which they were found. This vitiates any argument based upon the " hundreds of tons of bones " removed before the remains were brought to light. Further, these bones themselves are the remains of animals which are " recent " and do not include extinct types of high antiquity. Nor is any archæological evidence forthcoming, the only object said to be associated with the remains being a round stone similar to those used by the present-day natives for crushing grain.

In default, at present, of other data, it is necessary, therefore, to fall back upon the evidence furnished by the remains themselves. And here we are at once confronted by the contradictory characteristics upon which stress has already been laid. The gorilla-like face at once suggests a comparison with the oldest remains we know, those of *Pithecanthropus erectus*, consisting of a skull-cap and thigh bone found in Java in 1892, which exhibit, as the name suggests, a combination of affinity with man and ape, but belong to neither. The eyebrow ridges in Rhodesian man are even more prominent than in Pithecanthropus. Of other early remains available for comparison, there are the Heidelberg jaw, to which reference has been made, the Piltdown skull, itself a subject of controversy, and Neanderthal man, a type to which belongs a number of human remains of the Palæolithic age representing a race or possibly closely allied group of races who lived in Europe in rock shelters and caves during the last great extension southward of the ice sheet, and produced the flint implements known as Mousterian. To this group belong the Neanderthal skull, the Gibraltar skull, and a number of skulls found in France, Belgium, Germany, and as far East as Croatia. It is to this last-named group, which was superseded in Europe by the modern type of man, that Rhodesian man presents a close affinity, particularly in the prominent eyebrow ridges and the projection of the lower part of the face, both characteristics, however, being less marked in Neanderthal man. So far as the ape-like characteristics of Rhodesian man are in question, he would appear to stand somewhere between Neanderthal man and the gorilla. On this ground, then, it might be thought justifiable to place Rhodesian man in some epoch precedent to that of Neanderthal man, for whom a date of something like 50,000 years ago is generally accepted. On the other hand, the modern characteristics of the skull appear to preclude the attribution of such a high antiquity. Further, if the remains of the long bones belong to the skull, an assumption also made in the case of the fragment of sacrum, Rhodesian man walked upright in the posture of modern man, while Neanderthal man, on the evidence of his long bones, walked with a crouch. The probability would, therefore, lie on the side of Dr. Smith Woodward's conclusion that Rhodesian man represents a later development of the Neanderthal type, and that the incongruous combination of extremely primitive and modern characteristics is to be explained by Professor Elliot Smith's suggestion that in the course of evolution the last stage was the refinement of the face.

It would, therefore, appear that, so far as the investigation has gone, there is little evidence which would assist in giving a date to these remains, while the well-preserved character and comparative freshness of the bones yet remains to be explained. Our knowledge of the greater part of Africa, from the point of view of the history of human types, is negligible, and there is no reason to suppose that a primitive form of man might not have survived there into comparatively recent times.

I am greatly indebted to Dr. A. Smith Woodward for having most kindly supplied a photograph of the skull to illustrate this article.—E. N. F.

Helicopter Flying Machines

By "Rafex"

THE aeroplane is the only heavier-than-air machine which has reached a practical stage of development at the present time. Yet there are two other forms which have been experimented with at different times, and are still the subject of research. One, the Ornithopter, has a flapping-wing mechanism intended to be a close representative of the flight of a bird; the other, the Helicopter, is able to rise into the air directly from the vertical downward thrust of a helical screw revolving in a horizontal plane. The helicopter is the subject of the present article. It has lately aroused a revival of interest owing to the zealous work of several enthusiasts, some of whom have met with partial success. Until a few years ago its possibilities had been overshadowed by the achievements of the aeroplane, and indeed it had become difficult to realise that for many decades, if not centuries, the devotees of the heavier-than-air school had been divided into three sects, followers of the aeroplane, the ornithopter, and the helicopter, so far had the aeroplane outstripped the two others in practical results.

It may be asked, and somewhat pertinently, why, in view of the success of the aeroplane, anyone still continues in the endeavour to produce a practicable helicopter, since the aeroplane appears to fulfil all requirements. The answer is to be found partly in the native pertinacity of the human mind, particularly when of an inventive turn, in its refusal to desert a thing in which faith has once been put, and its glorious determination to overcome the obstacles to the solution of a problem once set; partly in the fact that the aeroplane does not in all respects satisfy the requirements of heavier-than-air flight. The chief point in which the aeroplane fails is that it does not bring aerial locomotion to the ordinary man's door. It is, in fact, more closely analogous to the train than to the motor-car, because it is necessary to travel by some other means of locomotion in order to reach the aeroplane's point of departure. (In parenthesis, it may be noted that if this comparison between the aeroplane and the train be true, the airship appears to be the equivalent of the steamship in its capacity to extend from continent to continent the trans-continental internal transport services provided by the aeroplane.) But why can an aeroplane not start at one's door? Simply because it requires an aerodrome of considerable extent over which to run as a land-borne machine before it takes or leaves the air. It is not even in as favourable a position as a railway train, as the space required for an aerodrome is greater than that required by a railway station, and cannot be provided within the precincts of a town. Before a journey by aeroplane can be commenced, it is therefore necessary to undertake a journey of, in most cases, some miles from one's own front door to the aerodrome; and it is this disadvantage which is seized upon by the helicopter enthusiast as the justification for his continued efforts. His point is that the helicopter could start from the roof of a house or any convenient flat space, in the very centre of a town if need be, and so combine the functions of train and motor-car. It is mainly this feature which spurs the inventor to persevere in his efforts.

The history of the helicopter is at least as old as that of the aeroplane, and, in fact, if models be considered, it may even be said that the helicopter achieved success, first, because many model helicopters of a toy form had risen into the air long before the first model aeroplane left the ground. In 1784, for example, two Frenchmen named Launoy and Bienvenu exhibited to the Académie des Sciences a primitive model helicopter which consisted of two four-bladed feather "screws" placed one above the other and caused to rotate by the untwining of a bow-string twisted round the connecting stick. In a famous paper contributed to *Nicholson's Journal* in 1809, and subsequently reprinted on two occasions by the Aeronautical Society, Sir George Cayley described the method of making a toy of this sort, which he called a "Chinese top." Incidentally, it may be mentioned that Sir George Cayley has frequently been described as the "Father of British Aeronautics," and, in fact, the papers contributed by him to *Nicholson's Journal* and the *Mechanic's Magazine* contain all the essential principles of both heavier- and lighter-than-air flight. His foresight was amazing, and there seems little reason to doubt that, had the petrol engine existed in his day, he would have succeeded in producing both a navigable airship and an aeroplane capable of flight. He was born in 1773, and, as he mentions in his paper of 1809 referred to above, his first aeronautical experiment was made in 1796 with the toy helicopter, and he was still writing on the subject of aeronautics up to a year or two before his death in 1857. Indeed, in a letter dated 1854 to Depuis Delcourt, secretary of the Société Aérostatique et Météorologique de France, he gives a description, accompanied by a rough sketch, of an improvement on "the clumsy structure of the toy called the Chinese top," produced by "Mr. Cooper of the London University," which he was "mounting, say, 20 or 25 feet." He goes on to state that he himself had had a still better model made of which he says: "It is the best I have ever seen, and will mount upward of 90 feet into the air." This consisted of three blades of sheet-tin, mounted on a box-wood nut, which was threaded

inside to fit on a threaded shaft. The shaft was revolved "like the common humming-top" by means of a cord wound round it, when the "helicopter" flew off into the air. This form of toy used to be a common object of the nursery. All Sir George Cayley's writings are extraordinarily interesting even at the present day, and he remains probably the only person in the history of the world who has ever explored the possibilities not only of airships and aeroplanes, but of helicopters and ornithopters as well.

It is impossible in a brief review of the development of the helicopter to mention any except a very few of the long line of experiments in this branch of flying, but no account would be complete without reference to some of the more notable of them. Coming to the twentieth century, one of the outstanding names is that of Louis Bréquet, mainly because he has since achieved fame as a designer of aeroplanes. His helicopter, which was built about 1908, was different from most if not all others, in being combined with an aeroplane. It consisted of a large biplane on the outer interplane struts of which a curious helicopter screw, the construction of which is somewhat difficult to describe, was fitted at each wing-tip. Each of these screws was really composed of four small sets of biplane wings at the extremities of two arms at right angles to each other, and mounted at their intersection on a circular frame, driven by gearing from the central engine. The Bréquet-Richet biplane-helicopter, as it was called, was certainly quite different from any other, and looking at it again in the light of M. Bréquet's subsequent career, it is not difficult to understand that from it should have been evolved the biplanes which are now so well known, as the machine was undoubtedly more of an aeroplane than a helicopter, the latter part of the design appearing more or less auxiliary to the former. Another helicopter of the same period, designed by M. Bertin, was unique in that the two superposed lifting screws, revolving in opposite directions—a common feature in helicopter design—were of quite different form and construction. The upper one, which was driven direct from the 50 h.p. engine, was of a metal type of construction common at that date, and had a diameter of about 10 feet. The lower one, on the other hand, which was carried on this same axis, was considerably geared-down, being designed to run at a very slow rate of revolution, and was composed of two monoplane wings mounted at each extremity of a horizontal arm, the total diameter being rather over 25 feet. A third interesting direct-lift machine of the first decade of the century was also designed by a Frenchman—M. Cornu. The pilot of this machine sat in a tubular steel framework, supported on four bicycle wheels, with the engine in front of him. Carried on steel tube outriggers running fore and aft from this frame were two large belt-driven pulleys with vertical axis. Mounted on the periphery of each of these pulleys were two fabric-covered monoplane surfaces, the angle of which to the plane of rotation could be altered at the will of the pilot. In addition to these, a rudder and elevator were fitted in front and rear respectively, though how these were expected to act is not quite clear.

From the purely theoretical standpoint, present-day knowledge of the principles of helicopters in regard to lifting force available and the possibilities of safe descent in case of engine failure is probably due to Colonel Rénard, for many years the head of the French Government's aeronautical experimental station at Chalais-Meudon, more than to any other person. This officer spent eighteen years on exhaustive researches into the question of lifting screws, obtaining measurements by means of aerodynamic balances, as a result of which he was able in 1903 to read three papers on the subject before the Académie des Sciences, which still remain the classic literature of the subject.

It is in fact now, one will not say easy, but well within the capacity of an aeronautical engineer to design a helicopter which will be capable of raising itself and its pilot from the ground and maintaining its position in the air. Unfortunately, however, the problem does not rest there, for if the machine is to be of practical use, the vertical motion must be transferable into a horizontal movement over the ground, and, further, it must have some measure of stability, be controllable while flying, and be such that its rate of descent is controllable under all conditions, with and without the engine. The generally accepted method of obtaining forward movement is to rotate the screws about their axis, so that they can drive the machine horizontally when it is partially supported by small aeroplane surfaces; or, where these are not provided, to set the screws at such an angle that their upward lift is still sufficient to maintain height while giving the machine translational motion. The latter method would appear to be one of obvious inefficiency, while in both cases the weight of the necessary gearing renders it difficult to imagine, in the writer's opinion, that the helicopter can equal the efficiency of the aeroplane on the basis of load carried per horse-power.

There are two distinct types of helicopter of the modern school: one having two screws mounted one above the other on the same axis, and the other having two or more screws each carried on a separate axis. The first has the obvious advantages of greater mechanical simplicity, for it involves possibly but one set of gears, and so saves weight; whilst the arrangement embodying separate axes will undoubtedly ensure greater efficiency of the screws, as there will be no interference between the two slipstreams. In both

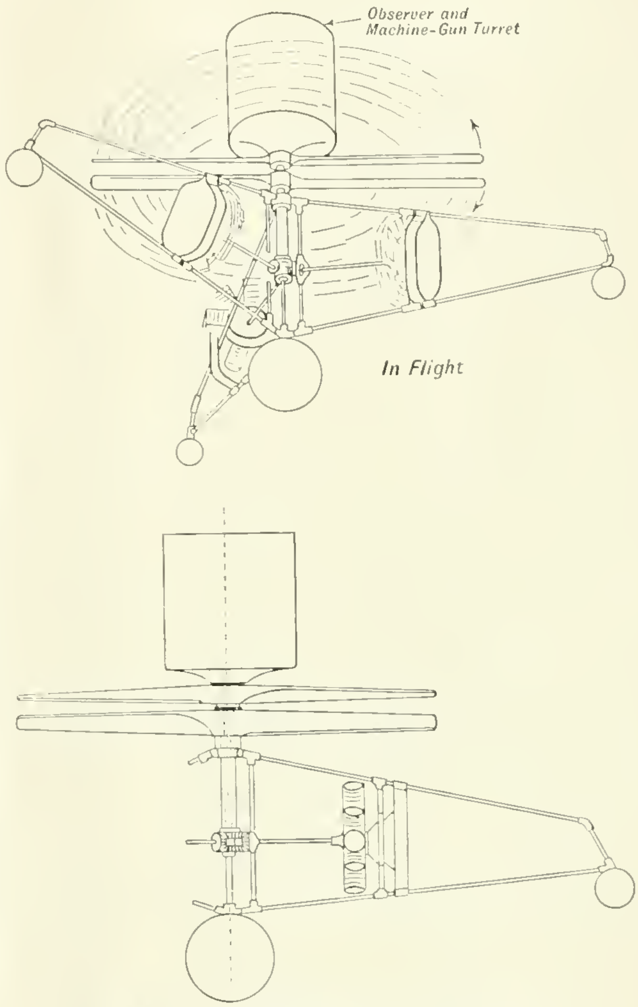
cases the screws are usually made to revolve in opposite directions, for otherwise the whole machine would simply be turned on its axis when the engine is started.

To the first class belongs the helicopter designed by a Spaniard named Pateras Pescara, with which trials have taken place at the Four Winds Aerodrome near Madrid, in the presence of officers appointed by the Aeronautical Department of the French Government. The machine, which has actually left the ground, though details of the flight are lacking, consists of what is to outward appearance a motor-car from which rises a vertical shaft. On the shaft are the two lifting screws, each of which consists of four arms in the form of small biplane surfaces. The chief feature of this machine is that each arm of the screws appears to be of ordinary aeroplane wing form, which one would not have thought likely to be efficient when following a rotary path through the air. Details of the span and engine power of this machine are unfortunately lacking, as are particulars of the mechanical design, although it is understood that the lifting screws can be swivelled for horizontal motion.

A promising American helicopter is the Crocher-Hewitt, the screws of which are 51 feet in diameter. Each screw consists of two tubular steel arms, at the extremities of which are the four blades made up of ribs riveted across the steel tube and covered with aluminium sheeting. Horizontal motion in this design is obtained partly by tilting the screws and partly by altering the position of small auxiliary surfaces, and utilising the down draught from the screws on these surfaces to drive the machine in the required direction. Two 100 h.p. motors are fitted.

Lieutenant Petroczy and Professor Karmen have produced in Austria a helicopter which is not designed for horizontal motion, but is intended to replace an observation balloon, as it is less vulnerable to attack from hostile aeroplanes and a smaller target for artillery. It is flown on a wire from the ground, and the observers sit in an armoured turret above the screws. The main framework consists of three horizontal frames, on which are carried the three 120 h.p. Le Rhone engines, which provide the motive power. Shafts from the three engines drive through bevel gearing two vertical shafts, one revolving inside the other, on which are carried the wooden two-bladed screws, each of which is 20 feet in diameter. This machine has made numerous ascents, and is said to have reached a height of 300 feet or more.

Of helicopters with the lifting screws working on separate axes, perhaps the best known is that of M. Damblanc, who read a paper on the theory of his machine before the Royal Aeronautical Society in 1920.[1] This machine has an ordinary aeroplane fuselage, with rudder and elevators, while in place of the wings are two four-bladed lifting screws of special design, somewhat reminiscent in shape of a clover-leaf. These screws, which are rotatable in order to obtain horizontal motion, are driven from two separate Le Rhone 120 h.p. engines. For safety of descent in case of engine failure, the angle at which the blades meet the air can be varied at the will of the pilot.



DIAGRAMMATIC SKETCHES OF THE KARMEN-PETROCZY HELICOPTER.

Another American helicopter, belonging to a different school from the Crocher-Hewitt, is the Leinwerer-Curtiss, which again has an aeroplane fuselage with a rudder, but no elevator. The means of sustentation selected here consists of four three-bladed propellers, arranged on a somewhat novel plan. They are placed in pairs on each side of the fuselage, each pair being mounted at opposite ends of a massive arm containing at its centre the gearing from which the drive is received from the engine in the fuselage. The arms

[1] *Aeronautical Journal*, vol. xxv, No. 121.

*

can be rotated about this point when it is desired to make the propeller axis horizontal.

In conclusion, the Oechmichen, another French helicopter, may be mentioned. The chief feature of this machine is the special form of screws used, which are two-bladed, each blade being shaped after the manner of a bird's wing. M. Oechmichen claims to have discovered a secret of bird flight in that certain birds or insects are capable of utilising in flight the suction caused by the passage of their wings through the air to give additional support, and it is to test his theory that these screws are designed. A screw of this kind is carried at each end of a light framework of box-girder design, the drive from the Dutheil Chalmers engine (of the remarkably low power of 25 h.p.) being by belting. In trials that have so far taken place, a small balloon was fitted above the machine, but the fact that this was merely to relieve the inventor, in the early stages of experiment, from having to worry over problems of stability, is evidenced by the fact that the helicopter rose from the ground with a total weight of 700 lb., although the lifting force exerted by the balloon was only 150 lb.

The multiplicity of ideas and the wide variation of design might lead one to suppose that the helicopter is merely a "freak," were it not for the fact that quite as much doubt regarding the correct line to adopt in aeroplane experimentation existed so recently as ten or eleven years ago. It would not be wise, therefore, to be misled by present-day conflicting notions, but to watch the trend of design as order arrives out of chaos. The solution of the problem will come, the present writer is inclined to believe, not through the sudden appearance of an epoch-making discovery, but from the steady development of known mechanical principles.

New Light on the Silver Age of Hellas

By J. U. Powell, M.A.

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The Mediterranean lands are slowly giving up their secrets. Several articles have appeared in Discovery dealing with the new light cast upon early civilisation in the Eastern Mediterranean by the discoveries in Crete and on the mainland. These discoveries reveal a civilisation which preceded the Greek age; and, although we cannot yet read the written records, we can largely reconstruct the history from the remains of the civilisation themselves. This paper deals with a later age, with fresh evidence upon the close of the classical Greek period, when its brilliance, though not its influence, had begun to wane. It is the period between the Athenian and the Roman age in the Eastern lands, roughly speaking from 350 to 150 B.C.

In the fifth century B.C. the great Athenian statesman Pericles is said to have proudly boasted that Athens was "a liberal education to Greece." But in these centuries we see, not Athens, but Greece becoming a liberal education to the nearer East through the conquests of Alexander, and to the rising and conquering power of Rome through the numerous centres of Greek culture spread over the shores of the Mediterranean.

The Greek literature which we possess is but a fragment—a large fragment, no doubt—of all that was written. But more is coming to light. Some of those authors who were little more than names, and whose works are only known to us by the briefest mention, are becoming personalities to us through recent discoveries, disinterred mainly from the sands of Egypt and the lava of Herculaneum.[1] They are not by any means all Athenian. The brilliance of Athenian genius in the fifth and fourth centuries B.C. has largely eclipsed that of the writers in other parts of the Greek world; but when Athens came to be only the most distinguished of many cultured cities after the middle of the fourth century, we can see more clearly how widely diffused and how prolific Greek culture was. After the death of Alexander the Great in 323 B.C. the kingdoms of the Eastern Mediterranean were thrown into the melting-pot. But meanwhile, in the central Mediterranean, another power, that of Rome, was rising and spreading its influence, and its great Empire was taking shape; a political success in its own strength, but intellectually inspired and infused by Greek thought. It was in these less brilliant centuries that those writers flourished who influenced Roman thought directly in the departments of philosophy and poetry, and it is the life of these important centuries that is now being continually brought to light from Papyri and inscriptions.

Let us take first that side of Greek life which has largely occupied the attention of scholars during recent years, and which may almost be called a new department of study—Greek Religion; and first the cult of Apollo. His oracle at Delphi was one of the most famous institutions of antiquity; and though the cult gradually decayed and finally vanished, a certain splendour surrounds it even in its later years. Two out of the five Hymns inscribed on stone and discovered at Delphi in the closing years of the last and the opening of the present century are remarkable, one for a vocal, the other for an instrumental, score which

[1] This was a Greek settlement on the shores of the Gulf of Naples overwhelmed by the great eruption of Mount Vesuvius in A.D. 79, and first rediscovered in the year 1738.

accompany the words. When we see the magnificent remains of Greek temples, as, for instance, at Athens or Paestum,[1] it is not difficult for the imagination to reconstruct the appearance which they presented when thronged by worshippers at some festival. Such a scene is presented by the words of these hymns, which speak of the processions, the choir singing and dancing, their long hair flowing down, the flutes playing, and the sweet incense rising into the air, as they celebrated the miraculous deliverance of the Delphic temple (in 278 B.C.) from the invading Gauls. The ritual had become a fine art, for we hear of guilds of professional performers at Athens. Strongly contrasted with such stately ceremonial is a primitive piece of magic ritual, appearing in a hymn found in Crete, in which the worshippers "leaped" to secure fertility for their flocks and fields, singing a kind of Rogationtide Litany. But there is little permanence for a religion consisting only of miracle and ritual, and less for one of magic, and these types were doomed to pass away. The higher aspirations of the period will come before us presently in a different form; meanwhile let us look at some pictures of ordinary life at three typical centres —Athens, Cos, and Alexandria.

Comedy is a good mirror in which to see contemporary life. The earlier comedies produced in the days of the Athenian Empire and the Peloponnesian War were largely political pamphlets. But by this time the keen political interest of Athens had passed away. The chief writers of the later or "New" Athenian Comedy, Philemon and Menander, present us merely with pictures of everyday life, a comedy not of politics, in earnest or burlesque, but wholly of manners; they hold up the mirror to social and private life, and so far they were among the teachers of their times.

In their dramatic writings we are introduced to a comfortable middle-class society, in which the father often goes a long voyage on business and comes back to find, like Odysseus, trouble at home. The son has been sowing his wild oats, dicing, drinking, falling in love, and then thinking of enlisting for Caria or far-off Bactria in some Foreign Legion; hence arise complications and difficulties, closed by a reconciliation; in short, the kind of incidents which meet us in the late Victorian novel.

Menander intended the spectator to profit by what he saw. Here is a characteristic passage from his play *The Guardians*:

"*Smicrines*. By the gods——

Onesimus. Gods? Do you suppose that the gods have leisure enough to assign good and evil day by day to each man separately?

S. What do you mean?

O. I will make it clear to you. Speaking roughly, there are a thousand cities in the world, each with thirty thousand inhabitants. Do the gods ruin or save each individual?

S. How could they? A laborious kind of life they would have!

O. 'Do they, then, take no heed of us?' you will say. Well, in each one of us they have implanted his character as the commandant of his soul. This inward power is one man's ruin, if he make a bad use of it, but saves another. This is our Daimon, the cause of each man's prosperity or failure. Make this Power propitious to you by doing nothing absurd or foolish, so that you may prosper."

Menander shows a genial good sense, which reminds one of Horace, and, like Horace, he is a mine of pithy sayings.

A story of real Athenian life about this time is brought before us in one of the newly-discovered speeches of Hypereides, a clever lawyer and orator of the fourth century B.C., in which a young booby of a country gentleman falls into the clutches of a fraudulent vendor and a courtesan. The story is this. The young man wanted to buy the freedom of a slave-lad who belonged to an Egyptian engaged in a perfumery business at Athens, but was told that this could not be done, unless the freedom of his father and his brother was also bought. The woman, in whose clutches he had already been, persuaded him to buy the three outright for about £120. A draft agreement was produced with suspicious promptness, and the vendor read out the terms, the buyer of course being in a hurry; soon after it had been sealed, the buyer discovered that he had bought not only the slaves, but also their debts, which the woman had represented to be small. But creditors sprang up on all sides, and the total amounted to no less than £1,200. One of the slaves had been the vendor's manager in the perfumery business, and these debts had of course been incurred by the vendor through his manager! No wonder that "to play the Egyptian" was an Athenian colloquialism for "to be a rascal"!

Pictures of vulgar life come before us in the island of Cos in the south of the Ægean. It was a busy and well-governed place, perhaps with a daily service of vessels between it and the great city of Alexandria; a literary centre, and possessing the tradition of a celebrated school of medicine. But it had a seamy side. The new author Herondas gives us scenes from everyday life, some rather sordid, in poems containing dialogues generally between women. In fact, women form the subject of all of them. They gossip about the "eternal servant question"; they attend worship

[1] This was originally a Greek colony, set on the shores of the Gulf of Salerno, about fifty miles south of Naples.

at the temple of Asclepius; and in one poem, the scene of which is probably laid at Ephesus, they spend time pricing expensive shoes in the shop of a glib and plausible shoemaker. Here is an extract:

"*Shoemaker.* Boy, open the box and bring out some of my best works of art. Look quietly in, madam, and open the shoe-case. Look at the heel, and the ornamented pattern on it! All good workmanship! And the grain! Incomparable! Look at the latest fashions! Here are your parrot-coloured shoes, your crab-coloured shoes, your scarlet shoes, your orange-tawny shoes; ankle-tips, night-trippers, laced boots, loose boots, slippers, sandals. Say what your heart desires.

Lady. How much do you want for the pair you took up first? Don't name too 'thundering' a price.

Shoemaker (*after some voluble protestations*). Three pounds ten, madam, not a farthing less."

THE BUST OF MENANDER IN BOSTON MUSEUM (U.S.A.).
(*Reproduced, by kind permission of Wm. Heinemann, from "Greek and Roman Portraits,"* by Anton Hekler.)

It is a high price, even for the extravagant lady; but after haggling, she buys some shoes, and the woman who introduced the customers is promised a pair as commission for herself. A vase-painting has been preserved of such a scene, a lady visiting a shoemaker and being measured. But in two of the pieces the figures are of a coarser and lower type, and in one of them the moral corruption inherent in ancient slavery appears very plainly. Among male characters we read of pugilists, garotters, gamblers, or seafaring men ashore for a carouse. The streets of the town are narrow, with mud up to the knees, like a Turkish town of the present day. The language put into the mouth of these people is that of common life, colloquial, full of vulgarisms, slang, and proverbs. The author is a "Realist" to the core, and has been well called the Teniers of Greek literature. His most entertaining piece is entitled *The Schoolmaster*; the characters in it are a truant boy, his angry mother, and a schoolmaster, on whom she is paying a parental visit. Her complaint is that her boy will not attend school, but prefers disreputable company, such as porters and runaway slaves, with whom he plays pitch-and-toss. Even when his father helps him to write from dictation, he will have none of it; and if he is scolded, he runs away to his grandmother's, or climbs up on to the roof and sits there like a monkey, and breaks the tiles, for which his parents have to pay. In short, he is an imp of mischief, and the neighbours put everything down to him. The schoolmaster promises to cure him, and in spite of his roars for mercy gives him a sound flogging; and even so, says his mother, the flogging has not been enough: "Whip him till sunset."

Let us now turn to Alexandria. Here, too, the Papyri give us glimpses of low life. The great port was the meeting-place of travellers from the Eastern and Western seas, and there were the amusements which we should expect in such a place. Scraps have been preserved apparently from farces performed in music-halls. One, for instance, perhaps from the first century B.C., introduces a tipsy sea-captain with his boon companions male and female. Another is part of a farce in which the scene was perhaps laid on the coast of Southern India, if the identification of the language in which one of the characters speaks is correct, for it is thought to be Kanarese. It is a story of adventure; a Greek maiden, held captive by Indian barbarians, is rescued by her brother, who makes the Indians and their king too drunk to pursue them. Not only were Greeks great travellers, but India had intercourse with Egypt. We know from the inscriptions of the great Buddhist, King Asoka, that there were Buddhist missionaries in Egypt in this period. Other fragments are of a lower nature and more sensational.

But we must not think that the morals of that generation in Egypt were as miry as the streets of Cos, or that its mind was as narrow and tortuous. More respectable people appear in the private correspondence of the Ptolemaic era (323–31 B.C.) which has come to light and which reveals a well-governed,

prosperous and industrious society of business men, farming on scientific principles, learning mensuration, draining and irrigating their arable land and vineyards, and paying rent and taxes. And in 245 B.C. we read of a strike of slaves who worked in a stone-quarry, and deserted. Nor were the amenities of social life wanting, as may be seen from the following letter of about the same year:

"Demophon to Ptolemæus greeting. Do your best to send me Petoüs the flute-player with the Phrygian flutes and the others; pay any necessary expenses, and I will refund them. Send me also Zenobius with kettle-drum, cymbals, and castanets, for the ladies require him for the sacrifice. Let him also be dressed in the finest clothes. Get the kid also from Aristion and send it to me; and send as many cheeses as you can, and a new jar; and vegetables of all kinds, and any delicacies which you have. Good-bye. Put them on board with the guards who will help to bring the boat."

One point of some historical interest appears. It is probable that in a letter of A.D. 41 we have the earliest known reference to the Jews as money-lenders. A person involved in some money difficulties in Egypt is written to as follows: "Say to him [i.e. to the creditor], I am not like anyone else, I am a lad. . . . We have many creditors; do not drive us out. Ask him daily: perhaps he can take pity upon you: if not, do you, like all people, beware of the Jews."

Turn now to the more serious side of this newly-found literature which meets us in the Philosophers and Moralists. The different schools of philosophy all had their popular teaching and they were the guides of life for the educated class. As we have already noted, works by Philodemus and Polystratus have been deciphered from the charred rolls of Herculaneum. They are popular expositions of Epicureanism; and there is also a similar exposition of Stoicism of a rather later date, the first century A.D., by one Hierocles. Polystratus, a new writer, with his earnest and intense convictions, reminds us constantly of the great Roman Epicurean Lucretius. "Only by the knowledge of the *Phusis*[1] of things," he cries, "can men be freed from their enslavement to False Notions and Perturbations, from all Commotions and Fears. This alone makes life free." But how serious these teachers were can best be seen from the remains of another Epicurean who lived in the second century A.D. In a small town called Œnoanda, some thirty miles inland from the Asiatic coast opposite Rhodes, a long and remarkable inscription was discovered a short time ago on a ruined stone portico. The philosopher's name was Diogenes, and the inscription which he wrote opens thus: "I have observed that mankind was worried and troubled and distracted with unnecessary matters; and I felt pity for their life and wept over the perdition of the times, and have decided that it is a good man's duty to come to their help." . . . With apostolic earnestness, and actually in apostolic language, he goes on: "Now that I am an old man and the sun of life is sinking, and I shall soon depart from life, I would do what in me lies. . . . Most men catch the infection of False Notions, one from another, like sheep. . . . I have resolved to make use of this portico to publish the Medicines of Salvation. It is right also to help those who will come after us, since they too are ours, even though they have not yet been born; and to help strangers too, for that is humane" ("philanthropic" is his word).

Place beside these a writer of quite a different tone, Cercidas, who lived in the third century B.C. and belonged to the school of philosophers called Cynics (lit. "doggish"), from their contempt for elegance and even for decent conventionalities. He may be regarded as practically a new author. He writes a lyric metre in a concise and mordant style, coining words with such facility and vigour that they produce a most emphatic effect. He inveighs against the unequal distribution of wealth, fiercely denounces luxury and high living, the "swinish wealth," enjoyed by "sepulchres of fat," as he calls the profiteers of those days, in two of his vigorous new words. "Why should spendthrifts and misers have the money, and not I?" he cries—and we fancy that many of our modern authors will heartily agree with him! "Is Justice as blind as a mole, and has the brightness of Themis been dimmed? How, then, do the gods come in, who have apparently neither the power of hearing nor of seeing?" He leaves the answer sarcastically to the "sky-praters," who he expects will not find the least difficulty. "But let help for the sick and charity to the poor be our care."

The idea of the community of property had been in the air during the fourth century. It had been ridiculed by the radiant wit of Aristophanes in the *Women in Parliament* and the *Plutus*; it had occupied the mind of Plato in the *Republic*, and met with the grave criticism of Aristotle in the *Politics*. But in the third century it had become a burning question in the south of Greece because of the military needs of Sparta. The most recent writer upon Cercidas suggests that his attack upon the grasping and vicious rich was meant as a warning to his own party (in his own city of Megalopolis, a near neighbour of Sparta) to mend their ways before it was too late, for the time might come when the rich would have to "disgorge."

The same theme is treated in a fragment of a new poem by Phœnix of Colophon, who lived about a

[1] The word means "the Law or process of Growth." The usual, but rather misleading, rendering is "Nature."

generation before Cercidas. He directs vigorous satire against the rich with their splendid houses and their immense property, while "their real selves are worth —three-halfpence." Two other poems attack the vice of greed: "Everyone is the moneyed man's friend: if you are a rich man, even the gods will love you; but if you are poor, your own mother will hate you."

Here we have, even in this later age, the old virility of Greek thought and its determination to cut to the root of the matter. And our own generation may well take to heart this splendid tradition of the Greeks, their eager quest for knowledge, their burning zeal for truth, their call to never-ceasing moral effort, in which they found their "Medicines of Salvation."

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The Problem of Graft-Hybrids

By F. E. Weiss, D.Sc., F.R.S.

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GRAFTING, i.e. the insertion of a small shoot or scion of one plant into a cut stem or branch of another living plant with a view to their uniting, seems to have been practised from time immemorial. It is said to have been carried out by that wonderful and inventive people, the ancient Phœnicians, and we have many records from Roman times of its practice. Vines were certainly grafted in those days, though for what purpose we know not, and it was evidently thought that plants quite unrelated to one another might be joined by grafting, for according to Vergil (*Georgics*, lib. ii)—

> "Vigorous apples are grown on the barren plane,
> A beech bears chestnuts, a mountain-ash the silver shine
> Of pear-blossom; under an elm have acorns been crushed by swine." [1]

We have, however, no experimental evidence that plants differing so widely from one another as those mentioned in the above passage can be successfully grafted one upon the other. Some degree of relationship, such as is indicated by their belonging to the same Family or Natural Order, seems to be necessary to enable the tissues of the two plants to unite. Thus a pear can be grafted upon an apple or on a quince, but not upon an ash.

Whether in the case of a graft the stock produces any change in the inserted scion or not has been a subject of great controversy. If any such influence were exerted by the stock, a good deal of the value of the process as practised at the present day would be lost, for valuable or choice forms are frequently grafted on wild stock. So far only one form of transmission of characters from stock to scion and vice versa has been scientifically established, and that is in the case of variegated plants. Shoots of plants with variegated foliage are often grafted upon common green stock, and the latter seems to become infected by some virus from the variegated scion so that all the leaves it forms later on will partake of the parti-coloured nature of the stock. Most of the other cases of apparent transmission of characters from stock to scion seem capable of explanation by the undoubted interference with the smooth passage of food-material across the line of union of the two plants.

There are, however, a few cases known of grafting having been followed by the production of shoots exhibiting characters intermediate between those of the stock and the scion. In these cases the graft has generally not succeeded, and after the inserted shoot or scion has died down to the base, a bud has been formed near the juncture of the two plants, and the shoot, which has arisen by growing out of the bud, has presented such a blending of the characters of scion and stock that it has been called a graft-hybrid, and has been taken to have resulted from a complete union of vegetative tissues similar to that of reproductive cells. This in the case of such different plants as we have in stock and scion might produce a seed-hybrid.

The first graft-hybrid recorded in scientific literature is the case of the famous Bizzaria Orange grafted in 1644 in Florence on a Lemon stock. This remarkable tree bore at the same time oranges and lemons and other fruits which partook of the nature of both kinds, either blended together or segregated in various ways, some, indeed, having an orange shell but a lemon pulp.

A better known instance of a graft-hybrid is that of the so-called Purple Laburnum (*Cytisus Adami*), which is very fully discussed by Darwin in *Animals and Plants under Domestication.* This interesting plant, specimens of which are now found in most botanical and in many private gardens, originated in Paris in 1825 from an attempt to engraft the small Purple Broom on the stem of the ordinary Yellow Laburnum. In

[1] Dr. A. S. Way's version.

this case too, as in the Bizzaria Orange, the graft did not succeed, but later a branch grew out from near the insertion of the graft, which in its foliage and flowers was intermediate between the stock and the graft. By many it was considered that it might perhaps have been a seed-hybrid which the nurseryman had endeavoured to graft upon the Laburnum, but no such hybrid is known, nor has it been possible to obtain this seed-hybrid of these two plants by the ordinary methods of crossing. Moreover, *Cytisus Adami* exhibits what is one of the most striking phenomena of graft-hybrids, namely the tendency to revert back to the constituent plants, which may be regarded as its parents. Thus three different types of foliage and flowers may after a time be observed on most of the specimens of *Cytisus Adami*. The flowers are represented by long grape-like inflorescences with flowers of yellow colour, shorter clusters of somewhat purplish flowers, while on the branches exhibiting the foliage of the Purple Broom small purple flowers are born in pairs. Such a segregation of characters on one plant is very rare in the case of seed-hybrids, but characteristic of graft-hybrids. A detailed microscopic investigation of the plant by J. M. Macfarlane also revealed the fact that the hybrid portion seemed to be "wrapped round, so to speak, by a skin" of the Purple Broom, which feature we may fittingly compare with the "orange shell and lemon pulp" of some of the fruits of the Bizzaria Orange mentioned above. Indeed, this peculiar form of segregation of characters in definite layers, as well as the tendency to reversion, seem to be characteristic of many graft-hybrids.

Early in the present century Dr. Hans Winkler set out definitely to produce other graft-hybrids, selecting for his experiments the genus *Solanum*, which seemed to him for certain reasons a very suitable subject. Grafting young shoots of the Tomato on the stem of the Nightshade and vice versa, he found that he readily got these two related species to unite. He then cut transversely through the region of the graft, thus exposing the living tissues of both plants. The wound so inflicted was rapidly covered by a healing tissue known as *callus*, upon which numerous new buds were formed. Some of these grew out into branches of Tomato or of Nightshade according to their point of origin, while in some cases where the two tissues were close together, a branch might be formed half of which was Tomato while the other half bore leaves and flowers of the Nightshade. Such growths he called *Chimæras*, after the fabulous monster of antiquity, part lion and part dragon. Very occasionally, however, shoots were produced in which the characters of the two constituent plants were blended, and these he regarded as graft-hybrids. They also showed a tendency to revert to their constituent parents, and an important feature was the fact that, though the shape of their leaves was intermediate, their outer covering was purely that of the Tomato or of the Nightshade according as to whether the latter or the former was

FLOWERING BRANCHES OF THE GRAFT-HYBRID (*CYTISUS ADAMI*) AND OF ITS PARENTS.

A. The Purple Broom (*Cytisus purpureus*) with small leaves and short purple flowers. B. The common Yellow Laburnum. C. The graft-hybrid, with leaves of intermediate size, and flowers in which the outer layer of the petals is purple, while the inner tissues are yellow. This gives the flower an intermediate colour.

the stock. It was, therefore, argued that in these experimental hybrids there had been no true vegetative fusion of cells comparable to the fertilisation of a seed, but that they represented the core of one plant surrounded by the skin of the other, very much as a finger may be covered by a glove. Further examination proved this to be correct. The internal cells partook of the nature of the stock, while the skin, or epidermis, was that of the inserted graft. Buds of this kind might readily arise from the wound tissue in which the cells of the two plants must be variously arranged, and in the production of a bud the inner cells of the stock might easily be covered by a cap of cells belonging to the scion. It has been suggested that, as these two types of cells largely preserve their own characteristics, these so-called graft-hybrids are really more of the nature of the chimæra mentioned above, but that, instead of the tissues of the two plants being side by

side, they are arranged one around the other. Such shoots may, therefore, be termed *Periclinal Chimæras*. A re-investigation of *Cytisus Adami* in the light of this new theory has shown that it, too, as adumbrated by Macfarlane in 1892, is of the nature of a periclinal chimæra, with the core of the Yellow Laburnum and the skin of the Purple Broom. Its tendency to revert to its two constituent components can, therefore, be more readily explained, and indeed it is possible to stimulate it to revert to the ordinary Laburnum by pricking its buds, thus injuring the skin, when the core pushes its way through to heal the wound, and thus the shoot becomes covered by a tissue similar to that constituting its core.

One feature interesting to note in this connection is that, though *Cytisus Adami* rarely fruits, its seeds when fertile always give rise, as far as is known, to the ordinary Laburnum. This can now be explained by the fact that the reproductive cells are formed from the inner tissues of the plant, and so are entirely those of the Laburnum. Similarly, in Winkler's so-called graft-hybrids the seeds never gave rise to hybrid plants, but only to the plant which formed the core of the chimæra.

A. A BRANCH OF ONE OF THE GRAFT-HYBRIDS OF THE MEDLAR AND THE HAWTHORN.

The leaves are less deeply lobed than in the Hawthorn, and are hairy like those of the Medlar.

B. A BRANCH OF THE COMMON HAWTHORN, FOR COMPARISON.

On the Continent it is very common to graft the Medlar on a Hawthorn stock, and in two instances graft-hybrids have been produced from plants grafted in this way. Their rare occurrence is, of course, due to the fact that in most cases such grafting is successful, and it is only when the graft fails or subsequently dies that there is a chance of a bud being produced which contains the tissues of both plants. *Cratægo-mespilus*, as the graft-hybrid has been called, is known in two forms, both of them intermediate between the Hawthorn and the Medlar, but one resembling the former more closely, while the other is more like the latter. In this case it is suggested that the form more like the Hawthorn represents a periclinal chimæra with one layer of Medlar cells clothing the Hawthorn core, while in the other form the covering of Medlar cells is more considerable. This explanation seems to fit some of the features exhibited by this interesting plant. Thus, for example, this hybrid's fruits, which in one of the forms resemble in shape and size those of the Hawthorn, are not red like our haws but brown like the Medlar, being clothed with a dark layer of cork characteristic of that fruit. Also the seeds of this form, when fertile, produce pure Hawthorns as one would expect in a periclinal chimæra. There are, however, some phenomena which cannot be so easily explained by the chimæra-hypothesis, and the subject is still under investigation.

Another graft-hybrid has recently been recorded by Professor Daniel, one of the foremost French authorities on grafting. In Brittany it is customary to graft certain forms of pears on a quince stock which has less vigorous roots than the pear, and thus keeps the trees in a more dwarf or pyramid condition and also promotes earlier and better fruiting. By cutting down to the point of union old plants which had so been grafted, Professor Daniel caused them to produce new shoots near the juncture of stock and scion, and some of these proved intermediate between the two. Though they have been produced some little time ago, they have so far not flowered—a fact which may be taken to suggest that they are true hybrids, or at any rate different from the so-called hybrids mentioned above, which flower freely. An examination of the leaves and stems seems to indicate that they are not periclinal chimæras, and it may well be that we have in this case a more intimate union of the vegetative tissues than in the examples cited above. We may, therefore, take it that, though the chimæra-hypothesis of graft-hybrids has cleared up some of the difficulties which have beset the investigators of these curious productions of horticultural practice and experimental skill, the last word on this subject has not yet been said, and that further work on this interesting problem in plant genetics is likely to be fruitful of important discoveries.

Irrational Fears

By F. A. Hampton, M.C., M.B.

FEAR, with its accompanying instincts of flight and concealment, is primarily a self-protective measure called out by the presence, or even more strongly by the approach, of danger. The attendant physical reactions, the quickened heart-beat, the deepened respirations, the sweating, and the increased tension of the muscles are preparations for the activity of flight, and, if our hair does not commonly stand on end, there are many who have experienced during the late war a certain uncomfortable feeling of tightness in the scalp which is equivalent to the raised hackles with which the cat or dog seeks to magnify his stature and inspire his enemy with the terror that he is probably feeling himself. Besides the impulse to flight, there is also a passive aspect to fear in which the individual becomes paralysed with terror ; and this seems to be the last extremity of fear, evoked usually in the face of overwhelming danger and corresponding to the reaction of shamming dead which is found in many of the lower animals.

The mental state, disagreeable though it be, also contributes to the scheme of protection, for it is one of intense awareness and alertness, an attitude expressed, it may be noted, by the roots of the word "apprehensive." As George Borrow said, "the eyes of fear are marvellously keen."

Both the mental and physical phenomena of fear may therefore be looked upon as reactions on the part of the organism to cope with a danger threatening it from without, but there are fears in which these reactions seem to have little or no protective value, for the exciting cause either contains no element of danger, or so little that the emotion evoked is altogether disproportionate, and we are tempted to call these fears baseless or irrational. But if we examine them carefully, we find that, however bizarre they may seem, they are nevertheless the result of a connected and logical train of thought ; the logic, it is true, may be childish logic, and such as the conscious mind would reject if it were able to criticise it, but the sufferer is unaware of the lines along which the fear is formulated and only receives the end-result of the process, so that the dread appears as an isolated phenomenon, inexplicable and mysterious.

Such fears are common enough to have been felt at some time by most people, and they do not, of course, connote any essential timidity of character, for there are few who cannot discover in themselves some private and particular fear, though out of self-regard it is often minimised as a mere aversion or antipathy. Many such fears stand out by their seeming incongruity with the rest of the character, and when they occur in great men we note and seem to prize them as a spot of weakness that marks the kinship of the hero with our common humanity. Grettir, the Saga hero, was afraid of the dark, Nelson was afraid of horses, and Napoleon of a cat.

While these fears are trivial enough in their effect to pass for mere eccentricities, yet they grade imperceptibly into neurotic conditions where life is made unbearable by fears that the victim realises to be irrational but cannot overcome by any exercise of will or reason. It is more especially to these fears, and for their relief, that the modern advances in psychology have been applied, but the discoveries made in this sphere illuminate equally those smaller fears of everyday life that we have hitherto accepted as capricious and inexplicable. These fears may be arranged, for purpose of description, in three groups : (1) Those of which the exciting cause seems to lie in some forgotten fright or shock, usually occurring in childhood ; (2) those cases in which detailed investigation discovers the presence of a hidden fear, whose existence the individual is unwilling to admit to himself and of which he contrives, by a purely unconscious and apparently effortless process, to remain unaware ; (3) those cases in which the fear is found to serve as the protection against the fulfilment of a hidden wish or desire.

As an example in the first group we may take the case of a person who was acutely afraid of stagnant water, but not (though he was unable to swim) of rivers or the sea ; this fear was found to date from a narrow escape from drowning in a stagnant pool when he was about four years old, an incident that he had completely forgotten and only recalled to memory after long trial. The fear persisted because he still continued to react to the pond or canal as a child of four, and it was only when the memory and association were restored that he was able to apply the criterion of adult experience and banish the fear.

In the second group the individual is afraid of something that he will not, or dare not, admit to being frightened of, but the *feeling* of fear cannot be altogether extinguished, and tends to find expression by some channel to which the conscience or *amour propre* can take no exception. The feeling, which is thus displaced from its true object, may—

(*a*) Reactivate a childish fear ; or

(*b*) Become attached to some object that can stand as a symbol of the true fear ; or

(*c*) It may intensify one of the common, instinctive fears of mankind.

(*a*) Many fears, that persist from childhood and are confidently attributed to some early shock, prove on close examination to owe their survival to reinforce-

ment from some secondary source of fear, and in cases where the original shock still remains vivid in the memory, the presence of some accessory factor is always to be suspected.

(*b*) The transference of a fear to its symbolic equivalent may be illustrated by the case of a man who was in greater danger than he supposed of yielding to a passionate attachment that threatened to wreck his family life ; he professed to feel master of himself and quite secure, but he developed an exaggerated fear of the house catching fire, and was unable to sleep from anxiety lest "something might be smouldering somewhere."

The fire was here accepted as a symbol or equivalent of passion, a simile stereotyped by common use, and though such a literal substitution may appear unreasonable, yet it is a process not altogether alien to our common mode of thought, for we see nothing bizarre in, let us say, the action of the German people in tearing down the Imperial monogram after the revolution.

(*c*) The common fears of mankind are those instinctive fears that appear, many of them, irrational in the setting of our civilisation, but which one may speculate to have been serviceable to our primitive ancestors. They include the fear of the dark, of open spaces (*agorophobia*), of being shut in (*claustrophobia*), of being alone, of heights, of the unfamiliar ; fears that we have all felt at some time, howsoever faintly. They represent a specialised and inherited sensitiveness to particular modes of stimulation, and they are easily reactivated by any free or diffused fear that is seeking a means of expression.

The nature of the particular fear is determined most often by its congruity with the true object of fear ; thus a boy, who has broken away from the home circle and set up for himself, may regret the security that he has left, and find, though too proud to admit it, something a little terrifying in his new liberty, and then perhaps he develops a strange fear of empty streets and wide open spaces, that symbolise for him his unprotectedness and isolation.

It is not without interest to endeavour to trace the origin of some of these common fears that seem to have outlived their usefulness ; the fear of darkness has still a protective value amongst those primitive tribes who are liable to night raids from hostile neighbours, and who compete on more or less equal terms with the nocturnal carnivora ; for the man who wandered care-free in the dark was a type likely to be eliminated by natural selection.

So the old mode of reaction lingers on, and we do no great violence to the theories of heredity if we see in the monsters with which a child peoples the darkness an unconscious recollection of the ancestral enemies.

The fear of open spaces is one to which few normal people would admit any liability, yet many of us, in crossing a wide, snow-covered field or a bare plain, may have caught in ourselves a tendency to glance backwards occasionally over our shoulder and felt a slight feeling of relief on reaching the "shelter" of the hedges and broken ground. And no one, in selecting a table in an empty or half-empty restaurant hesitates to prefer one against the wall to one in the centre of the room.

If we analyse a little this uneasiness called out by open spaces, it resolves itself into a feeling of being unprotected, especially from behind, and perhaps it is not altogether fanciful to see ourselves reacting here as primitive man, with his relatively inferior powers of flight, would and does react when caught at a disadvantage in the open. In this situation there is probably a secondary factor in operation, for man is a gregarious animal and liable to an acute feeling of uneasiness when separated from the protection of the herd.

In the choice of a "sheltered" position for meals we have, perhaps, a faint relic of that feeling of shame that many primitive tribes still attach to the act of eating, a feeling probably derived from the fact that the animal when preoccupied with the physiological functions, such as nutrition, excretion, and reproduction, is relatively defenceless, and for greater safety tends to carry them out in concealment.

The origin of the fear of heights as an instinctive fear seems almost to elude explanation, however speculative. Unlike the foregoing fears it is the reaction, though an excessive one, to a real danger, and it also differs from them in being almost absent in childhood, seeming to become more acute towards the end of life, so that the author of Ecclesiastes (xii. 5) gives it place among the disabilities of old age.

It has been referred, somewhat fancifully, to an instinct inherited from some arboreal ancestor, but there is no strong reason for believing that man's immediate progenitors were tree-climbing animals, or, if they were, for supposing them to have been liable to this particular fear. An origin has also been looked for in the fear of falling from the nurse's arms, a relatively tremendous height to a baby, and here the emotion might have a protective value if it were accompanied by a tendency to cling to the mother, a reaction that is rather less marked in babies than might have been expected.

The fear of height is, for the majority, excited most keenly on the top of a tower or the promontory of a cliff, and is often more intense when looking both down and outwards than when looking straight downwards. It is accompanied by an urgent desire to cling hold of something solid, which lends a little colour of proba-

bility to the theory of infantile origin. The feeling of fear is attached not only to the actual height, but also to the immensity and emptiness of surrounding space, which evokes more than a hint of that nightmarish terror of the infinite; yet for ninety-nine people out of a hundred there is no feeling of height in an aeroplane, unless it comes when flying alongside a bank of solid-seeming clouds, or when flying low near tall buildings, so that we seem unable to gauge, or even realise, the height unless there are intervening objects over which the eye can travel. This fear, which is one of the most intense, seems to affect adult civilised man more than children or primitive races, and to be absent in animals, so that we are tempted to associate it with a widely developed consciousness and to hazard that perhaps it reflects some deep inward sense of littleness and insecurity evoked by an image of the abyss and the concept of annihilation.

The dread of death is commonly held to be an instinctive fear, and Francis Bacon so classed it with no uncertainty when he said that "men fear death as children fear to go in the dark," but it is very doubtful whether normal man, fearful though he may be of injury and violence, is deeply afraid of death as such, seeming rather to go his way believing "all men mortal but himself," and where we find the fear of death a prominent trait in character we are inclined to suspect the presence of contributory, hidden fears; so that the dread of death should, strange as it may seem, properly find a place among the irrational fears, though, on account of its special relationships, there is not enough space to treat of it in this present category.

The origin of an irrational fear from a hidden wish or desire may be illustrated by the case of a clerk, underpaid perhaps, in a firm whose business methods are not over-scrupulous. He finds that he has opportunities of making money safely at their expense, but, being a strictly honest man, he neither yields to the temptation nor has he any conscious fear of doing so. Presently, however, he develops a fear that he may have borrowed stamps from the petty cash without repaying them, that he may have cheated the firm by using the office stationery for his private correspondence, and finally he develops an unreasonable nervousness of policemen. The fear thus becomes a most effective safeguard against yielding to the unconscious wish.

The classification of the processes by which an irrational fear may arise is necessarily artificial, for several may, and indeed usually do, contribute to a given case, as can be seen in the following example in which nearly all the processes dealt with coexist:

A young married woman developed rather suddenly an intolerable fear of being alone in a room; she could give no reason for it, except that she had been slightly nervous in a similar way as a child, after she had been frightened by an old man peering through the window. She said that she had no cause to be afraid of anything. On examining the fear more closely, she could only add that she felt as though "something would happen" to her if she continued to stay in the room. On being asked to let her mind go free and try to imagine what might happen to her, she produced slowly and with long pauses the following picture: "I feel as though the floor might open up. And now I see a square opening lined with bricks; it is very deep and there is dark, muddy water at the bottom of it. (*Long pause.*) There is someone at the bottom who wants to pull me in. I can't see who it is. . . . Now I can see . . . it's M." M. was a man with whom she had been on affectionate terms before her marriage; he had lately reappeared in her life, but she "had tried to keep him out of her thoughts." She had been warned that she would "get into deep water," if she had anything to do with him. It took considerable time to analyse this vision, but eventually it was found that the brick lining and the water suggested a disused shaft of which she had been afraid as a child, for a small boy had been drowned in it, and his fate had been held up to her as a warning "because he ought not to have gone there, but he had been tempted by the chestnuts that were lying about." The fear of yielding to temptation (which implies a forbidden wish) and the resultant scandal and disaster were symbolised by falling or being dragged into the muddy well in which the little boy had been drowned —a little boy who, to her childish eyes, had been thus terribly punished for yielding to temptation. The localisation of the fear in the closed room was determined partly by the reactivation of a childish fear and partly by the feeling of being "hemmed in" that corresponded to the conditions of marriage hampering her freedom. She was afraid of being alone, because only if alone with the man would she be in danger of that intimacy that she both desired and feared. The symptomatic fear disappeared in this case, as it often does, so soon as its meaning was realised. But it is not to be assumed that all is well with the individual when this has been accomplished; he is the better off in being able to react directly and consciously to his difficulties, but his chief gain will probably lie in overcoming the tendency that led him to remain in ignorance of the true source of his fear.

For the irrational fear is in most cases the expression of an unsuccessful attempt to evade the real fear; the problem is relegated to depths below our conscious self and is there dealt with on lines that we can recognise as belonging to the mode of thought of the child or of primitive man—the type from which

our conscious mode of thought has evolved and with which it must, therefore, by the laws of development, retain a connection.

The conscious self can say, "It is *as though* I were standing alone and unprotected," or "It is *as though* I were getting into deep water," but to the primitive child-self the metaphor is real; to primitive man a "murderous look" is no figure of speech but actual fact, and the child soundly kicks the loose stair-rod for its hostility in tripping him up. Here there is no "*as though*," for that comes later in our development, and by its use we rob this mode of thought of its potentiality of being translated into actions that we have learned from experience to be futile. Besides treating the metaphor or symbol as a reality, there is another primitive trait in the expression of the irrational fear, for in almost all the examples quoted we find that the primary cause of fear lies within ourselves and is, at bottom, a fear of ourselves, which is displaced on to some external object. The operation of projection is a common mental process, more especially among primitive people, and is sufficiently illustrated by the belief that we are more commonly tempted by the devil than by our own wayward instincts.

In the case of fear it has this value, that it provides an outlet by which the fear can in some measure be "worked off," and its attachment to an external object enables the sufferer in neurotic cases to believe that by taking precaution he can escape the fear or safeguard himself against it, but as Burton says [1]: "Melancholy men have an inward cause, a perpetual fume and darkness, causing fear, grief, and suspicion, which they carry with them, an object that cannot be removed, but sticks as close as a shadow to a body—and who can expel or overrun his shadow?"

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UNIVERSITY INTELLIGENCE

TRINITY COLLEGE, Cambridge, offers for the second time a Research Studentship, of a value varying with the need of the student but not exceeding £200 a year, to a non-member of the University of Cambridge who proposes to enter that University in October 1922 as a candidate for the degree of Ph.D. Applications should be sent as early as possible in July, and not later than July 25, to the Senior Tutor, who will supply further particulars on request.

[1] In *The Anatomy of Melancholy*, first published in 1621. There is an edition of it in Bohn's Standard Library.

Primitive Architectural Canons

By Arthur Bowes, A.M.I.C.E.

In architecture, as distinct from building construction, the relative proportions of the various parts of a building are an essential factor if it is to embody conceptions of beauty or any suggestions by the use of symbols. Measurement and the adoption of units of measurement thus become necessities in the primæval stages of the art. In the July issue of DISCOVERY, I showed how the Hexapla or Six-pointed Star, the Pythagorean or 3.4.5 triangle, and other simple geometrical figures were largely used in early ages as unitary measures, and how, also, these fundamental figures can still be traced in the design of structures where their presence has been hitherto unsuspected. I offer some further examples here in the hope of inducing more detailed investigations into a subject both wide in extent and historically interesting.

The Hexapla, or Double Triangle or Six-pointed Star, is probably the most ancient of such unitary figures on account of the ease with which it could be constructed. It is based on the aggregation of equilateral triangles, and would be formed in primitive times by the use of three measuring rods of equal length placed end to end. Strings or cords might have been used, as we know definitely that they were used very early in Egyptian civilisation, but the measuring rod is one of the most venerable appliances. It still exists amongst us, if only in name, as the "rod, pole, or perch" of land measure, varying in length from $5\frac{1}{2}$ to 8 yds., while our yard measure and 6-ft. staff are everyday examples.

In setting out the Hexapla on the site of a building, the process would be something like the following. The centre point would be first decided upon, then the triangle ABC formed by placing the rods end to end as in Fig. 1. The rod AC being left in position, AB and BC would be transferred to new positions in order to form the triangle ACD, and so on until the whole figure was completed. The accuracy would be checked by the closing in of the last and first triangles, and also by the prolongation of the lines to the outside points, or "landmarks," indicated by the figures 1, 2, 3, 4, 5, 6. The use of the Hexapla has been so largely dealt with in architectural literature that it will be sufficient here to call attention to some examples not referred to by other writers. In Lincoln Cathedral the vertical section of the south transept is based on three hexagons such as form the central part of the Hexapla. The ground plan of Coningsburgh Castle is obviously a hexagon. In the Rhine Valley

the churches of Trèves, Speyer, and Freiberg have their plans based on either one or two hexagons. It is especially interesting to find, by examination of the plans in Sir E. A. Wallis Budge's handbook of the Nile, that the temples of Karnak, Medinet Habu, and Denderah reveal the same method of planning.[1]

The revival of classic architecture gave birth to a multitude of arbitrary rules derived from the study of the finest buildings of Greece and Rome in the hope of emulating their beauty of proportion. Some of these rules, even when divorced from classic design, remained in use until the Victorian age. Thus it was held that beauty of design in any rectangle, such as a window opening or panel, was ensured when the width and length equalled respectively the side and the diagonal of a square, that is to say, were as 1 to 1·414. For simplicity the approximation 7 to 10 was used by the craftsman. The same rule was also applied to the designing of elliptical brick arches over doorways and will be found recommended for this purpose in 1840 in the *Surveyor and Engineer*, a technical journal of the time.

The construction of a right angle by means of a triangle whose sides were in the ratio of 3.4.5 was a process familiar to the "rope stretcher" or surveyor of Egypt, China, and India in the earliest ages, and the influence exercised by this figure on the design of buildings in later times was dealt with at some length in the previous article in DISCOVERY.[2] Some further examples of its use are now offered, but to show in detail the various methods in which it was applied would necessitate more space for illustrative plans than can well be spared here. The references, then, are intended chiefly as indicating where confirmation of the statements of its use may be found. If the plans of York Minster be examined, it will be seen that three diamonds—each formed from four 3.4.5 triangles with their four right angles in juxtaposition, in the manner formerly described—will fill the width and length of the nave from the west end to the altar, and another half-diamond will complete the length to the east end of the building. In Beverley Minster and, possibly, in Newark Church, the same figure determines the principal proportions. In the church at Bradford-on-Avon, built by St. Aldhelm in the eighth century, the dimensions of the chancel, according to Sir W. Besant's *London*, are 10 ft. by 13 ft. 2 in. On the supposition that the 3 by 4 rectangle had been the originating figure, it will be seen that a width of 10 ft. should theoretically require a length of $10 + \frac{10}{3}$, or 13 ft. 4 in., being within 2 in. of the recorded length.

A building which is permeated throughout by this root-figure is Magdalen College, Oxford. In the *British Architect* of September 15, 1907, measured elevations will be found, and investigation will show that the pitch of the roofs is based on the use of the 3.4.5 triangle, while the whole façade of the elevation may be divided into rectangles measuring 3 by 4, each rectangle being composed of two 3.4.5 triangles placed "head to tail."

The interior angles of the 3.4.5 triangles are respectively 90°, 53° 8′, and 36° 52′. The architect, when preparing

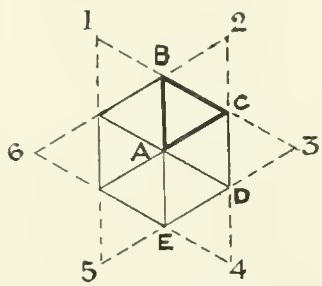

FIG. 1.—SETTING OUT THE HEXAPLA.

his drawings, included among his instruments a set-square made to this shape, and when he wished to design a gable, either at the end of a roof or as an ornamental feature, he made use of such one of the three angles as suited his purpose. Examples of all three uses are plentiful; as an example of the use of the intermediate angle, reference may be made to the measured drawings of a richly decorated sepulchre at All Saints' Church, Hawton, illustrated in the *British Architect* of February 19, 1911. French and Italian architecture of two or three centuries ago exhibit many instances of the same controlling methods.

The most romantic of all discoveries in this connection, and one which lifts the theory into the domain of popular interest, is that which clearly establishes its relation to the Pyramids of Egypt. It is generally supposed that if anything can give weight to the validity of a new idea, whether it relate to the precession of the equinoxes, the squaring of the circle, the chronology of history, the weights and measures of England, or the coinage of America, no argument can surpass the calling in of the Pyramids as witnesses to its truth. Their confirmatory evidence is irresistible

[1] In the previous article in DISCOVERY, the Manchester Free Trade Hall was referred to as having been designed from the proportions of the Vesica Piscis, which is the figure formed by placing two equilateral triangles base to base. By calculation it can be shown that in such a figure the relation of width to length is 1 to 1·732. An example of the use of this proportion in Indian architecture so long ago as 257 B.C. will be found in Mr. E. B. Havell's *Handbook of Indian Art* (John Murray, 1920). On p. 24, in the description of Lomas Rishi Cave, near Gaya, it is stated that the interior hall measures 33 ft. long and 19 ft. wide. These dimensions are in the ratio of 1 to 1·736, a negligible difference.

[2] Vol. II, No. 19, July 1921.

and conclusive. Let me, then, describe the manner in which this venerable enigma of the builder's lore lurks, unseen by the average eye, in the unchanging lineaments of the Pyramids. For some years I tried unsuccessfully to find a relation between the slope of the Great Pyramid and any of the angles of the 3.4.5 triangle. Failing in that direction, I directed my attention to some of the others out of the many Egyptian pyramids and met with the following extraordinary result. In the *Encyclopædia Britannica* the slope of the Second Pyramid, that of Kephron, and also of the seventh, eighth, and ninth pyramids, is given as 53° 10′. The discrepancy between the 53° 8′ of the 3.4.5 triangle and this statement of the measurement by engineers is, as a matter of material practice, so small that there seems little reason to doubt that in the building of these pyramids the 3.4.5 triangle was used to regulate the slope of the sides in the manner shown in Fig. 2. The agreement is so close between the theoretical angle and the angle recorded as measured that in the Second Pyramid, whose height is given as 472 ft., the recorded height is within a few inches of the theoretical height. When we take into account the ill-defined surface of the stonework, the instrumental and personal errors, the theory may fairly be regarded as a true explanation.

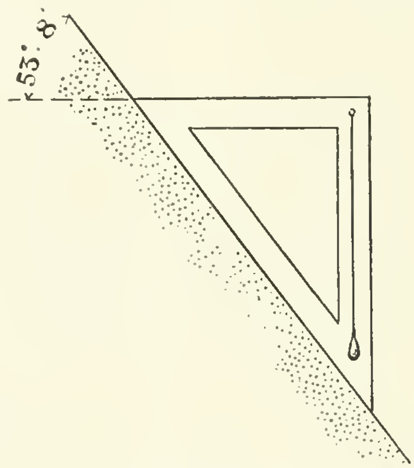

FIG. 2.—A FAVOURITE SLOPE OF PYRAMIDS.

Even in the Great Pyramid itself, although the slope of the side cannot be made to conform with this theory, there lies a cryptic revelation of the 3.4.5 proportions hidden in the dimensions of the King's Chamber, the very nucleus of the stone immensity.

The dimensions of the King's Chamber are given as 34 by 17 ft., with a height of 19 ft. The floor is a simple oblong, twice as long as it is broad—a figure which has some little interest in itself, yet, in view of what follows, the simplicity of its design might almost be considered as an intentional blind to divert one from the true secret concealed in the dimensions. The curious relation of width to height, 17 to 19 ft., lacking, so far as I could find, any feature of interest, led me to probe in other directions, and finally I discovered that an imaginary 3.4.5 triangle will exactly fit into the chamber if the 4 side is assumed to lie along the foot of one of the side walls with the opposite angle of the triangle raised until the 5 side forms the solid diagonal of the chamber. The diagram in Fig. 3 will make this clear.

The statement is not an airy creation of fancy. If the measurements, on which the calculations are based, are correct (and there is no reason to doubt their accuracy), then the result is a mathematical certainty. Taking the 34 ft. as representing one side—the 4 side—of the 3.4.5. triangle, the 3 side is the diagonal of the end wall, that is to say, $\sqrt{17^2 + 19^2} = 25{\cdot}5$. Then, to find the 5 side of the triangle we have $\sqrt{25{\cdot}5^2 + 34^2} = 42{\cdot}5$. The three sides of the imaginary triangle are, thus, 25·5, 34, and 42·5. These will all divide by 8·5, and are found to be in the ratio of 3.4.5.

The work of setting out the dimensions in this chamber would have been carried out more easily by cords than by rods. Three of the priestly architects working in solitude, so as to preserve the special knowledge which they alone possessed, would determine the intended height of the chamber by the simultaneous stretching of two cords. Once the height had been determined, the polished red granite blocks forming the walls would have been built up, the roof slabs laid, and the superstructure completed. The treasure buried in the heart of the Great Pyramid was not a hoard of gold or jewels that could be ransacked; it was entirely immaterial; an idea, not a

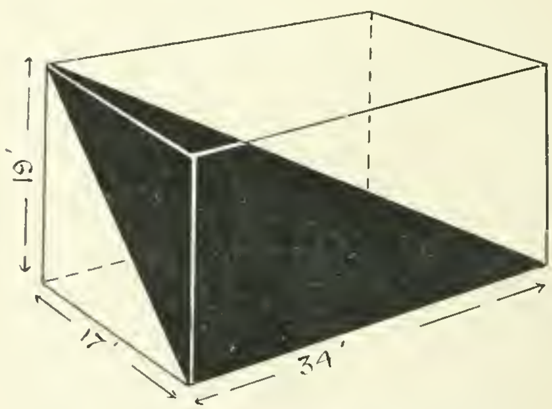

FIG. 3.—THE SECRET OF THE KING'S CHAMBER.

tangible thing; and so it came about that through forty centuries of turmoil and change it rested there an unsolved mystery, the most baffling of all the puzzles in Time's amusing toy-shop.

An Eighteenth-Century Character

(Continued from p. 300, Vol. II, No. 23, and concluded)

By Rowlands Coldicott, M.C., B.Litt.

Peter Pindar's Lyric Odes are difficult to quote: their merit lies in their originality. They read easily, are full of clever similes and audacious criticisms. In them for the first time one finds that mixture of tale, fable, conversation in verse, and comic ode that for many years to come Peter poured forth with such facility. In this early pamphlet occurs the phrase "brother of the brush" which ever since has been in common use among artists. Ode VI contains his rollicking tribute to Wilson the landscape painter—a rare piece of discerning criticism, for Wilson's greatness has only lately been fully recognised. Wolcot says:

". . . Till then old red-nos'd Wilson's art
Will hold its empire o'er my heart
By Britain left in poverty to pine.

"But, honest Wilson, never mind;
Immortal praises thou shalt find,
And for a dinner have no cause to fear,—
Thou start'st at my prophetic rhymes:
Don't be impatient for those times
Wait till thou hast been dead a hundred year."

But the pamphlet did not pay its way, and it was not till 1785 that he knew success. Kersley—who a quarter of a century earlier, when Wolcot was a young medical student in London, had stood literary godfather to Churchill—now came to him and made him an offer. The price of the pamphlets increased, first to a shilling, then to half a crown. He began to have imitators. About the middle of the year he struck a vein which was destined to bring him much gold. It was a happy hour for him when he conceived the bold idea of turning the king into a kind of comic figure. Byron came later to give the final damaging blow in his *Vision of Judgement*; it was Wolcot who prepared the way. It is true that there were many others. The wits of the Rolliad, Dr. French Laurence, General Fitzpatrick, Tickell, Richardson, and others were not too scrupulous in their Probationary Odes to point out the private absurdities of George the Third—but no one specialised in him like the man who laughed behind the mask of *Peter Pindar*.

All Wolcot's satires of the monarch can be found in those five volumes of verse, mostly comic, published in 1812—the "works" of *Peter Pindar*. In fable, tale, and ode, even in mock-heroic epic, the farmer-king is systematically "rotted." Did Tom Warton write a birthday ode to him, *Peter Pindar* was ready to hold it and its royal subject up to ridicule. Did the king stir out of his palace, *Peter Pindar* would scatter broadcast over the town *his* version of the adventure. His best-known tale—one that found a place in children's books of the last century—the story of the apple-dumplings—relied for its humour on the personal eccentricities of George. His best piece in dialect describes the arrival of the king in Devonshire. Another most amusing tale is the description of the king's visit to Whitbread's Brewery. It occurs as an elaborate piece of by-play in a pamphlet entitled *Instructions to a Celebrated Laureate*. A short quotation will show how extraordinarily clever he was in reproducing the king's peculiarities:

"How did his Majesty so gracious say
To Mister Whitbread, in his flying way,
'Whitbread, d'ye nick th' Excisemen now and then?
'Hae, Whitbread, when d'ye think to leave off trade?
'Hae, what? Miss Whitbread's still a maid, a maid?
'Wha, what's the matter with the men?

"'D'ye hunt? hae, hunt? No, no, you are too old.
'You'll be Lord May'r, Lord May'r one day;
'Yes yes, I've heard so; yes, yes, so I'm told:
'Don't don't the *fine* for Sheriff pay;
'I'll prick you every year, man, I declare.
'Yes, Whitbread, yes, yes; you shall be Lord May'r.

"'Whitbread, d'ye keep a Coach, or job one, pray?
'Job, job, that's cheapest; yes, that's best, that's best.
'You put your liveries on the *Draymen*, hae?
'Hae, Whitbread, you have feather'd well your nest.
'What, what's the price now, hae, of all your stock?
'But Whitbread, what's o'clock, pray, what's o'clock?'

"Now Whitbread inward said, 'May I be curst
'If I know *what* to answer *first*.'"

Wolcot is so well known to students of the end of the eighteenth century as a ribald rhymester who made a living out of being impudent to the king that no one has yet perceived that his works are strewn with vestiges of greatness. Side by side with low tales and cheap knockabout tricks in comic dialogue, similes and illustrations exist that show an immense capacity for observation and a huge stock of varied knowledge. If he described anything, he makes you certain that he has seen it. These illustrations, popping up in his imagination on the slenderest excuse, are worked out with a care worthy of better pages, but appear—such is his art—to have been dashed off with a light and careless hand, as in this passage of the Whitbread tale:

"Reader, dids't ever see a Waterspout?
'Tis possible that thou wilt answer 'No.'
Well, then, he makes a most infernal rout;
Sucks, like an elephant, the waves below,
With huge proboscis reaching from the sky,
As if he meant to drink the Ocean dry.
At length, so full he can't hold one drop more,
He bursts: down rush the waters with a roar
On some poor boat——"

His descriptive methods in this extract are those of Byron in *Don Juan*. Moreover, the movement of the first three lines very nearly resemble many of Byron's. There are passages in Wolcot where, in addition to similarity in speed, movement, and pose, he almost—but not quite—stumbles upon the "Don Juan Stanza." He was, without doubt, a precursor of Byron, and without doubt Byron read him well. It is possible to consider carefully these curious relationships between poets without forgetting for a moment how widely asunder in point of achievement they may be.

Yet Wolcot was, in truth, capable of many things; of an epigram:

> "A poet and a kingdom and a cat
> Should never never never be too fat."

of enunciating a philosophy:

> "Care to our coffin adds a nail, no doubt;
> And every Grin, so merry, draws one out.
> I own I like to laugh, and hate to sigh
> And think that risibility was given
> For human happiness, by gracious Heaven!
> And that we came not into life to cry;
> To wear long faces, just as if our Maker,
> The God of Goodness, was an Undertaker,
> Well pleased to wrap the Soul's unlucky mien
> In Sorrow's dismal crape or bombazeen.
>
> "Methinks I hear the Lord of Nature say,
> 'Fools, how you plague Me! go, be wise, be gay;
> No tortures, penances, your God requires:
> Enjoy, be lively, innocent, adore;
> And know that Heaven hath not one Angel more
> In consequence of groaning Nuns and Friars.
> Heaven never took a pleasure or a pride
> In starving stomachs, or a horsewhipp'd hide.'"

And now this Ballade shall prove whether Wolcot is not a better writer than scores of poets and rhymers who still receive an absurd amount of attention in histories of English literature:

> "BALLADE
>
> "Couldst thou look into myne Hearte,
> Thou wouldst see a Mansion drear;
> Some old haunted tower aparte,
> Where the Spectre bands appear:
> Sighing, gliding, ghostly forms,
> 'Mid the ruin shook by storms.
>
> "Yet my Hearte, whiche love doth slighte,
> Was a Palace passing fair;
> Which did hold Thyne image bright,
> Thee the Queen of Beauty rare;
> Which the laughing Pleasures fill'd
> And fair Fortune's sunne did gild.
>
> "When shall my poor Hearte, alas,
> Pleasure's Palace be again?
> That, sweete Mayde, may come to pass
> When thou ceasest thy disdaine:
> For thy smiles, like beams of day,
> Banish Spectre forms away."

That is not an isolated instance. In his "new old ballads" many tuneful songs are to be found, their subject-matter based upon close reading of the Elizabethans. Wolcot was deeply read in English literature: even his earliest Truro Lampoons show that he was well conversant even at that time with Chaucer. Later in life he spoke and wrote strongly about the universal neglect of Shakespeare. His natural bent led him to the study of comic writers, of whom he considered Hudibras the greatest.

After the collected edition of his works was published, Wolcot, now grown old, settled down for the rest of his life in a little cottage in Somers Town, which stood in a gardener's ground called "Montgomery's Nursery." It is now the precincts of Euston Station, but at that time was a rural retreat. Here until the year

GEORGE AND THOMAS WARTON BEING KNOCKED OFF PEGASUS BY WOLCOT'S SATIRE.
A caricature by Rowlandson, illustrating *Ode upon Ode*, by *Peter Pindar*.

of his death he remained, infirm and blind, but still writing. It is possible to see him distinctly amongst his possessions in these last years. Behind the door, and opposite a broad window that opened to the ground, stood a square piano. On it lay his favourite Cremona violin, which is still preserved in a house in Canada. His armchair faced the fire, the piano was on his right. A landscape by Wilson hung over the mantelpiece and two enamels by Bone. On his shelf was a Shakespeare, second folio. He could still strum the piano and play the fiddle, and even occasionally composed light airs for amusement. When writing verses he generally employed an amanuensis. But he also continued until shortly before his death to write with his own hand, one stanza on each piece of paper. Several of these essays of the old blind poet are in the possession of the present writer.

There is nothing in English literature quite like the burlesque style of Dr. Wolcot. Utterly unscrupulous in

attack, he is able, with satire, invective, irony, and sheer fun at his command, to set before us a feast that both attracts and disgusts. In him literature is expressed in the lowest possible terms, and Life and Death sit subject to the spirit of mockery. To Wolcot must be paid this tribute—that in his best burlesque passages not a word is out of place. He was master of his craft, and though a large quantity of inferior work could be spared from his volumes, his best is in its own way final. This man is not one of your small writers who have only once or twice contrived to express themselves notably ; there is in him a careless ease that claims companionship with the great. At times, perhaps in the most unexpected places, there is present in his verse a movement like a heavy ground swell, a grand manner that recalls Dryden, the expression of something pent up, the fervour that makes a style. Often it is mated with words not in themselves expressing remarkable sentiment. The artist is greater than the man.

Wolcot stands confessed in his works, and does not need a final apology. His five volumes of verse are unique in our literature. Even as a mere guide-book to the last quarter of the eighteenth century they are worth more than the few pence demanded by bookshops in the Charing Cross Road. He is also worthy of study as a character, an exceptional human being. Much is known about him. Much remains to be collected.

(*Concluded*)

BIBLIOGRAPHY

There are numerous editions of Wolcot's works. The best is in five volumes, with a short life, printed in 1812. None is complete. All his pieces were originally published in single quarto pamphlets. The fullest life is that in *Annual Obituary and Biography*, 1820. By far the best article is that in *West Country Stories*, by W. H. Hamilton Rogers, 1895, entitled "The Sweeter Side of Peter Pindar." Among other source books too numerous to list there are :

Polwhele's *Traditions and Recollections* (for the Truro period).
Opie and his Works, by J. Jope Rogers, 1878.
Opie and his Circle, by Ada Earland, 1911. (Hutchinson & Co.)
Past Celebrities, by Cyrus Redding.
Records of My Life, by John Taylor, 1832.
"An Academy Critic of 100 Years Ago," *Magazine of Art*, 1883.
Public Characters. American Edition, 1803.
Crabbe Robinson's Diary sub. 1811 (in MS. at Dr. Williams' Library, Gordon Square—a vivid unfavourable personal sketch).

All the above must be read with caution. References abound in late eighteenth-century reminiscences. See also *Notes and Queries* (2nd Series, vol. vii), early files *Morning Post* newspaper, *Blackwood's Magazine*, July 1868. Much unpublished material is extant, particularly a manuscript life, with portraits and letters, contemporary, compiled by a Mr. Giddy. This is drawn upon in the present article. It does not shed much light on Wolcot's later life. There are manuscripts in the public library, Auckland, New Zealand.

NOTE.—There is an excellent portrait by Opie in the National Portrait Gallery. Also a delightful miniature of Wolcot in his old age, by Cosway. The author would be glad to hear from anyone who has knowledge of manuscript, verses, or letters, or specimens of Wolcot's painting.

Reviews of Books

Forensic Chemistry. By A. LUCAS, O.B.E., F.I.C. (Edward Arnold & Co., 16*s*.)

A forensic chemist is a solver of chemical problems that arise in connection with the administration of justice. He is a man who should combine the qualities of a first-class analyst with those that go to the making of a successful detective ; an expert who sits in the office of his laboratory, waiting like Sherlock Holmes for the man in difficulties to ascend the stair.

The author of this work is the director of the Government Analytical Laboratory in Cairo, and his book, as far as the reviewer is aware, is the only one published on this interesting application of chemistry to life. It should appeal not only to students of chemistry, as more or less light reading, but also to that large class in the community, the authors and readers of detective stories.

Forensic chemistry deals not only with purely chemical questions like the nature and composition of any material whose quality may give rise to legal proceedings, but also with the examination of articles for the presence or absence of particular substances such as poisons, or compounds which may have originated an explosion or a fire. It is concerned also with questions which are only partly chemical, such as the examination of blood-stains, finger-marks, documents whose authenticity is questioned, and counterfeit coins.

In each chapter Mr. Lucas gives a careful statement of the problem, and in some, but not excessive, detail the general line of attack upon it. He then quotes from his large experience in Egypt several examples which illustrate and justify the methods employed. Finally, he gives the references to books in which that particular subject may be further pursued.

In the chapter on bullets we have these illustrative cases. A man, who was suspected of wounding another by shooting, escaped conviction because the shot from a cartridge discovered in his home was found by analysis to differ from the shot extracted from the wounded man ; the former contained a comparatively large amount of tin, and the latter a trace of antimony, but no tin. In a second case a night watchman shot at some unknown persons suspected to be thieves, who succeeded, however, in getting away. Next morning blood was found on the ground, and later a man was arrested with a shot-wound in his leg for which he was unable to account satisfactorily. The analysis, however, proved that the composition of the lead extracted from the wound differed from that of the slugs in the watchman's cartridge. Both had antimony as an impurity, but the amounts of these impurities differed. The man was consequently released.

In the chapter on clothing we have the following remarkable story. A waistcoat was submitted to a chemical expert with a request for information concerning its owner, who was found near the Suez Canal in suspicious circumstances during the war. The waistcoat appeared almost new, but had a stain in the lining (probably due to per-

spiration) and a bone button bearing the address Batavia and a name, probably that of a tailor. Portions of the waistcoat were soaked in distilled water, and the solutions obtained examined chemically. These contained various compounds of calcium, magnesium, sodium, etc., in about the same proportion as they exist in sea water. It was also concluded that a very fine quartz sand, found in each pocket, was dune sand. The deductions from these facts were as follows :

The owner of the waistcoat had bought a ready-made suit of clothes in Batavia. The stain proved that the lining had been used before, since the stain had not been acquired while the lining was in its existing position. An old lining on a new-looking waistcoat suggested a ready-made suit rather than a second-hand one. The man had travelled to Egypt in a Dutch steamer (the only steamers which then called at Batavia and passed through the Suez Canal). He had left the boat surreptitiously while it was passing through the Canal, and had swum to shore. He had not waded, because the presence of sea-water salts even at the top of the waistcoat suggested entire immersion. He had landed from the Canal at a place where there were sand-dunes. This was indicated by the nature of the sand found in the pockets.

These conclusions were subsequently proved to be correct.

One of the most interesting chapters in the book is the account of the methods used in the detection of counterfeit coins. In this particular work the camera and the microscope are particularly valuable adjuncts. The chemist is required not only to analyse the counterfeit coins, but also the materials seized on the premises of suspected persons, which may include metals, moulding composition, and miscellaneous chemicals. It is also part of his job to know the most up-to-date methods and apparatus employed by coiners, as well as the methods employed in minting the genuine article.

In one case, in the house of a man suspected of producing counterfeit coins, were found several pieces of white metal and some similar-looking metal adhering to the end of an iron rod, which had manifestly been used as a stirrer. The defence was that these articles had been used merely for tinning copper saucepans, a common practice. Analysis, however, proved that both the pieces of metal and the metal on the rod were identical in composition with the counterfeit coins, and differed considerably from the material ordinarily employed for tinning saucepans. The man was convicted.

The reader will find especially interesting the chapter on the detection of forgeries in documents, which includes also an account of secret writing and sympathetic inks; also the chapters on poisons, on the preservation of the human body, and on the detection of robbery from letters and parcels.

It is a good book, and very interesting.

A. S. R.

Radio-activity and Radio-active Substances. By J. Chadwick, M.Sc., Ph.D. (Sir Isaac Pitman, 3s. 6*d*.)

This, the latest volume of Pitman's Technical Primers series, is the most up-to-date exposition of the physical side of radio-activity in English, and no better book on the subject could be recommended for the senior class of schools and to university students reading for honours in physics. It is an introduction to the study of radio-active substances and their radiations, the nature of radio-activity, and the bearing of radio-active transformations on the structure of the atom. It follows in the main the lines of Sir Ernest Rutherford's great book, *Radio-active Substances and Their Radiations*, published in 1913, but it is very much shorter, it omits references to authorities, and time has enabled it to include an account of the valuable additions that have been made to the subject during the last eight years. Dr. Chadwick has one advantage over many writers of textbooks—he knows his subject from the inside. This is useful knowledge, for it helps an author to write on occasion a book which is not merely informative, but arresting and stimulating; one, like this one, that is worth buying, reading, and keeping.

The author has included the results of the most recent work on radio-activity in this book. The treatment is simple, concise, and strictly scientific. He bases his exposition on the modern conceptions of atomic structure, and does not pay much attention to the historical order of discovery. This is no doubt wiser and makes for clearness, but a short historical description, if it be genuine, may provide an excellent opportunity for an author to recall to his readers' minds the main facts and theories with which he assumes them to be familiar before he begins his self-appointed task. It would have been a gain, I think, if Dr. Chadwick had led off in Chapter I with a diagram demonstrating the place of the radio-elements in the periodic system, and followed it up with a short description of atomic number.

A. S. R.

Taboo and Genetics. By M. M. Knight, Ph.D., Iva Lowther Peters, Ph.D., Phyllis Blanchard, Ph.D. (Kegan Paul, Trench, Trubner & Co., Ltd., 10s. 6*d*.)

This book is a survey for the general reader of the sexual factors that influence the life of the community; it is divided into three sections, a biological, sociological, and psychological, each of which is written by a separate author.

The biological section, by Dr. M. M. Knight, is an elaborate but lucid summary of the more modern work on the biology and physiology of sex, from which the author draws the conclusion that the difference between the sexes is a quantitative one, *i.e.* a question of degree rather than the expression of an absolute qualitative difference.

The sex of the individual is determined at a very early stage by a bias impressed upon the chemical processes of metabolism, a bias that is maintained throughout life by the chemical secretions of the ductless glands; so that the sexual character comes to depend immediately upon the balance of the endocrine or ductless gland system, and if this is disturbed, corresponding changes in the sexual characters will ensue.

From the qualitative nature of the sex differences it follows that considerable variations are found in the degree

of masculinity and femininity of individuals, and it may be said that the pure type, 100 per cent. male or 100 per cent. female, only exists as an abstraction ; the author therefore makes a plea on biological grounds for a less rigid and uncompromising view than is usually held of the contrast between the sexes. The greatest distinction, he finds, lies in the structural specialisation of the female for the task of supporting the life of the embryo during its intra-uterine existence, a point that is not very clearly followed up in the rest of the book.

In the second (sociological) section, Dr. Iva Peters gives a complete survey of the taboo of women, that complicated and rigidly enforced code of *things forbidden* by which primitive man limits his association with women or anything connected with them, and so protects himself against the evil influence that he believes to emanate from them. Crawley's theory, that this taboo is designed to protect man from the possibility of being " infected " by the weakness and inferiority of the other sex, is recorded, but no mention is made of his teleological explanation that the taboo serves to maintain the specialised division of labour between men and women, which would be of service to the community in maintaining the high degree of efficiency that is favoured by specialisation. It may be noted that the sexual taboos tend to emphasise and reinforce the difference between the sexes, as though primitive man had at bottom some deep horror of their approximation. The taboo of women is next traced into its development as the fear of witchcraft ; then, with the fear sumblimated into awe, as the veneration of the sibyl and prophetess ; and finally, by what the psychologist would call reaction formation, into the ideal of the pure, spiritual woman, asexual and ethereal, culminating in the virgin goddess.

The author points out that the old sexual taboos are still powerfully operative in modern communities and are responsible for much unhappiness and injustice, but she makes very little attempt to trace the influences of the taboo feeling in its many and particular results, and the only remedy that the author proposes against its evil effects—and she appears to assume, what is not quite justifiable, that all its effects are evil—is the complete sexual education of the young and a more open treatment of sex problems generally. But surely something more than this is required, for the taboos are not mere customs that we have preserved by imitation, but the expression of deep-seated, and for the most part unconscious, mental tendencies, and until the lines along which they affect society have been worked out and become common knowledge, it will be difficult to apply the rational outlook that the author demands to these primitive traits that seem, so disastrously in many cases, to have outlived their usefulness.

In the third section, which is in many ways the most stimulating and original, the book comes directly to the actual problems with which society is faced. Dr. Phyllis Blanchard discusses the disharmonies of sexual life, the unhappy marriages, the preference for celibacy and the vagaries of the sexual impulse, in terms of the individual. She sees that society ignores the variation in degree of masculinity and femininity that were indicated in the first section, and sets up the ideal of a standard type to which its members must endeavour to conform even at the cost of their individuality.

She shows that the tendency to conform to the rigid standard goes deeper than a desire " to do the right thing," explaining it on the lines, recently set out by Kempf, of a " conditioned reflex "—that is to say, a reflex that is thrown into activity not only by the normal stimulus, but also by objects usually associated with it, objects that may become in time an essential condition for the excitation of the reflex and even become more powerful in arousing it than the normal object. It is, for instance, a matter of common observation that our feelings of affection can be aroused by almost any attributes of the person that we care for, and even when they occur in other people. Our affections become no longer liable to be excited by any sexually pleasing person, but the reflex is only aroused upon the condition that he or she possesses some of the attributes of the person of our choice. Trouble ensues when the individual falls in love with some imagined ideal of manhood or womanhood, created by society or by special factors in the early environment, only to find that the model who has excited their affection does not fulfil the real demands of their personality, for the natural reflex has been " conditioned " by the ideal standard.

The author seems to feel that the choice of a mate is becoming a matter of greater nicety among civilised people because of increasing individualisation, or, rather, the greater need felt by the individual for the free expression of his personality, a change that is naturally more marked in women, for whom new spheres of activity are constantly being opened.

The rigid standards and ideals of society tend to lag behind the needs of the time and make marriage more hazardous and less attractive, so that many men and women frankly question whether it is worth while, or, if they are less reflective, they decide that their failure to conform to the standard ideal indicates some radical shortcoming in themselves which makes marriage an impossibility. But the sexual impulse demands satisfaction, and if the normal channel is closed, it tends to find a vicarious expression, as, for example, in romantic friendships with another of the same sex, or in other less obvious manifestations of wayward affection. A potent source of disharmony is also found in the fact that the maternal and sexual impulses, though united in the model woman, are not always closely correlated, but frequently exist the one without the other ; a peculiarity that the author seems to regard as innate, though it seems likely that in many cases it is an acquired and remediable condition, due to the repression of an instinct by some accident of circumstance.

Dr. Blanchard's section is a thoughtful examination of the problems of society, and is warmly recommended to those who find simple explanations of the " unsatisfactoriness " of modern men and women and do not hesitate to print them.

The joint authorship of the book has made it possible to gather together a great amount of specialised informa-

tion and to include the most recent advances in each aspect of the subject, but these advantages are purchased at the cost of obscuring somewhat the relevance of certain of the facts accumulated round the problems under discussion. It is written for the most part in non-technical language, and should prove stimulating reading to anyone with the smallest interest in the sexual problems of to-day. Each chapter contains a useful bibliography.

F. A. H.

SHORTER NOTICES

Examples in Optics. Compiled by T. J. I'A. Bromwich, Sc.D., F.R.S. (Bowes & Bowes, 2*s.*)

One hundred and forty-four questions in physical and geometrical optics, set in the Cambridge manner, for honours students of applied mathematics.

A Catalogue of British Scientific and Technical Books. (British Science Guild, 6 John Street, Adelphi, W.C.2, 10*s.*)

The British Science Guild is a national organisation, founded in 1905, to promote the application of scientific methods to social problems and public affairs. Its latest activity in promoting the use of knowledge, and thereby furthering the development of education, science, and industry, is in producing this catalogue. Its compilers have attempted to make a complete record of scientific and technical books at present in print other than those intended for primary schools and elementary volumes of a like nature. Books at present out of print, and American books even when published also in this country, have been purposely omitted. The volume contains more than six thousand titles, and the particulars given for each book are author's name, title, size of page, number of pages, date of last edition, name of publisher, and current price.

Particular care has been paid to classification, and the compilers very wisely have called in experts in the different branches to assist. At the end of the catalogue is a subject-index, and an index of authors and translators, which serve to make reference quick and easy.

The Making of Reflecting Surfaces. A Discussion by members of the Physical Society of London and the Optical Society held in November 1920. (The Fleetway Press, 5*s.*)

This pamphlet, copies of which may be obtained from the secretary of the Optical Society at the Imperial College of Science and Technology, consists of a survey of the bibliography of metallic deposition on glass, with papers on the processes of silvering mirrors, reflectors, quartz and glass fibres, and cognate subjects, by H. N. Irving, J. W. French, of Barr & Stroud's, F. Ellerman and H. D. Babcock, of Mount Wilson Observatory, C. R. Davidson, of the Royal Observatory, Greenwich, R. S. Whipple and W. G. Collins, of The Cambridge and Paul Instrument Co., Prof. Chas. Fery, of Paris, F. Simeon, of Messrs. Adam Hilger's, Julius Rheinberg, and J. W. T. Walsh. Following the papers is a report of the general discussion.

Studies in North Africa. By Cyril Fletcher Grant. (Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 8*s.* 6*d.*)

This is the abridged edition of a much larger work published in 1912, *'Twixt Sand and Sea.* And it has been excellently abridged too, so that there is not a sentence that does not convey to the reader the atmosphere of or information about the " land of sand and ruin and gold," as Swinburne described it. Mr. Grant has spent many years in North Africa, and speaks with authority on the successive waves of civilisation that have swept through it from the arrival of the Phœnicians in 750 B.C. to that of the French in 1830, and the wonderful ruins that these civilisations have left in their tracks.

We look forward to reading its companion volume that is to appear later. The illustrations are excellent, but we wish that specimens of statuary and mosaic had been included amongst them.

Marvels of the Animal World. By W. S. Berridge, F.Z.S. (Thornton Butterworth, Ltd., 7*s.* 6*d.*)

A great deal of fascinating and out-of-the-way knowledge has been gathered into these pages, which are popularly written and well illustrated. Particularly interesting is the chapter on " Poisonous Animals," but the reviewer, after his own experiences, advises no one to read it just before retiring to bed !

Books Received

(Books mentioned in this column may or may not be reviewed in this number, or in a later number.)

AGRICULTURE

Dates and Date Cultivation of the 'Iraq. By V. H. W. Dowson, Agricultural Directorate of Mesopotamia. (Part I, 10*s.*; Part II, 5*s.* Printed and Published for the Agricultural Directorate of Mesopotamia by W. Heffer & Sons, Ltd., Cambridge.)

ARCHÆOLOGY AND ANTHROPOLOGY

A Textbook of Archæology. By Prof. R. A. S. Macalister, Litt.D. (Cambridge University Press, 50*s.*)

The Evolution of Civilization. By Joseph McCabe. (Watts & Co., 2*s.*)

Annals of Archæology and Anthropology, University of Liverpool. Edited by T. E. Peet. Vol. VIII, Nos. 3–4. (Liverpool University Press and Constable & Co., Ltd., 6*s.*)

BIOLOGY AND BIOCHEMISTRY

Considérations sur l'Être Vivant. Deuxième Partie. Par Charles Janet. (Beauvais : Imprimerie Dumontier et Hagué.)

The Glands regulating Personality. By Louis Berman, M.D. (The Macmillan Company, New York.)

GEOGRAPHY

Exploration of Aïr : Out of the World North of Nigeria. By Angus Buchanan, M.C. (John Murray, 16*s.*)

The Historical Geography of the Wealden Iron Industry. By M. C. DELANY. (Historico-Geographical Monographs. Benn Bros., Ltd., 4s. 6d.)

A Concise Guide to the Town and University of Cambridge. Originally written by JOHN WILLIS CLARK, M.A., etc. Seventh edition, entirely revised. (Cambridge: Bowes & Bowes, 1s. 9d.)

POLITICS, SOCIOLOGY, ETC.

Foreign Governments at Work. By HERMAN FINER, B.Sc. (Econ.), etc. (Humphrey Milford, Oxford University Press, 2s. 6d.)

Under New Management: A Book for Business Men and Others. By HUGH P. VOWLES, M.I.Mech.E. (George Allen & Unwin, Ltd., 6s.)

PSYCHOLOGY AND PSYCHO-ANALYSIS

Morbid Fears and Compulsions. By PROF. H. W. FRINK, M.D. (Kegan Paul, Trench, Trubner & Co., Ltd., 21s.)

The Psychology of Medicine. By T. W. MITCHELL, M.D. (Methuen & Co., Ltd., 6s.)

The Gate of Remembrance: The Story of the Psychological Experiment which Resulted in the Discovery of the Edgar Chapel at Glastonbury. By F. B. BOND, F.R.I.B.A. Script by JOHN ALLEYNE. Fourth edition with a record of the finding of the Loretto Chapel in 1919. (Oxford: Basil Blackwell, 7s. 6d.)

LITERARY CRITICISM

Literature and Life. By E. B. OSBORN. (Methuen & Co., Ltd., 7s. 6d.)

RELIGION

Theological Education at the Universities. By the REV. PROF. ARTHUR C. HEADLAM, C.H., D.D. (Oxford: Basil Blackwell, 2s.)

The Process of Man's Becoming. By "QUÆSTOR VITÆ." With preface by DAVID GOW. (Duckworth & Co., 8s.)

SCIENCE

The Emission of Electricity from Hot Bodies. By PROF. O. W. RICHARDSON, F.R.S. With Diagrams. Second edition. (*Monographs on Physics.* Longmans, Green & Co., 16s.)

Applied Electricity. By S. R. ROGET, M.A., etc. (*First Books of Science Series.* Macmillan & Co., Ltd., 2s. 6d.)

Applied Calculus: An Introductory Textbook. By F. F. P. BISACRE, O.B.E., M.A., etc. (Blackie & Sons, Ltd., 10s. 6d.)

Edinburgh's Place in Scientific Progress: Prepared for the Edinburgh Meeting of the British Association. (W. & R. Chambers, Ltd., 6s.)

CORRECTION

The price of *New Chapters in the History of Greek Literature*, edited by J. U. POWELL and E. A. BARBER, and published by the Clarendon Press, is 10s. 6d., and not 18s. 6d., as mentioned in our December list of "Books Received"

Correspondence

UNEMPLOYMENT

To the Editor of DISCOVERY

SIR,

I have read with interest Professor Knoop's article on the problem of unemployment in your November issue, but I am afraid I do not agree with him. Unemployment is, in my opinion, not the penalty of capitalism and of industrialism. There is no unemployment in Germany and in Belgium. It is principally due to the unreasonableness of organised labour. There cannot be universal over-production. There can only be ill-balanced production. The great business of the world has always been and is still the exchange of goods between town and country. The prices of country goods, of raw materials, of foodstuffs, etc., have fallen disastrously. Grain, copper, rubber, and many other things are below 1914 prices. The raw producers and farmers throughout the world have been vastly impoverished, but organised labour both in England and in the United States refuses to allow the lowering of wages or the speeding up of production, and the result is that the impoverished people throughout the world cannot buy manufactured goods from England and the United States, but buy them from Germany, Belgium, and other countries which produce more cheaply.

There need not be any unemployment in this country. Hundreds of thousands of houses want building and millions are in shocking disrepair. The housing trade and the trades connected with it could give work to a million people, provided that labour was reasonable, and gave a fair day's work for a fair wage. At least 500,000 servants are needed, but they are not obtainable. Meanwhile half a million women are drawing the dole. The Continent has been impoverished by the war, the oversea countries by the fall in prices, and England by over-taxation. Unemployment is due to the fact that labour refuses to cut its coat according to the cloth available. The shops are full of imported goods which Englishmen refuse to produce at prices which the consumer can pay.

What is wanted is not so much the lowering of wages as the speeding up of production. Doubling output means halving labour costs. On an average the American worker produces as much as three English workers.

Yours, etc.
F. ELLIS BARKER.

ALBION LODGE, FORTIS GREEN,
EAST FINCHLEY, N.2.
November 24, 1921.

To the Editor of DISCOVERY

SIR,

The suggestion contained in Mr. McLaggan's letter *re* unemployment in your December number appears to rest largely on the assumption that it is essentially technical or craft knowledge that is required for the successful carrying on of an industrial enterprise. It

consequently ignores the very important part played by business capacity in the successful conduct of a business undertaking. However efficient a firm may be on the technical side, it will be unsuccessful unless it is able to buy its raw materials at satisfactory prices, and to sell its output on favourable terms.

As small "one-man" undertakings would be unable to avail themselves of the economies of large-scale production—use of machinery, specialisation of labour, etc.—their prospects of becoming firmly established would be very small, even if times were good. When times are bad, their chances of success, even with adequate capital, would be negligible. In almost every case the capital would be lost. The proposal does not strike me as one which either the State, or a bank, would be wise to finance.

With reference to Mr. Ellis Barker's letter, I do not think that the differences between us are really fundamental; he stresses certain aspects of the problem, whereas I attempted to examine it in a more general way.

Absence of unemployment in Germany is to be accounted for by the inflation of the currency adopted there leading to temporary, but highly artificial, trade prosperity. I referred in my article, with disapproval, to this method of stimulating trade. With regard to Belgium, I do not understand Mr. Barker's statement that there is "no unemployment"; according to the official figures in the *Labour Gazette*, 21 per cent. of the members of the Belgian unemployment funds are out of work at the present time. Mr. Barker attributes unemployment in this country principally to our high costs of production, which, in turn, he accounts for by "the unreasonableness of organised labour." I mentioned high cost of production as one of several causes of unemployment, without attempting, however, to express an opinion as to which cause was most important. I am quite prepared to admit that high cost of production is a very important factor in the present situation, though I should hesitate to say that it is the principal cause of unemployment. Nor should I like to attribute high cost of production entirely to "the unreasonableness of organised labour."

Yours, etc.,
DOUGLAS KNOOP.

THE UNIVERSITY OF SHEFFIELD.
December 5, 1921.

CHRISTIAN SCIENCE, AND SUGGESTION AND AUTOSUGGESTION

To the Editor of DISCOVERY

SIR,

In your November issue there appears an article entitled "Suggestion and Autosuggestion," by Robert H. Thouless, M.A., in which he makes a misleading reference to Christian Science.

Christian Science is not a process of suggestion or autosuggestion; formulas are not used in its teaching or practice. Mrs. Eddy, its Discoverer and Founder, certainly makes the statement on p. 421 of *Science and Health with Key to the Scriptures*, "There is no disease," because she also declares that "God, Spirit, is all, and there is none beside Him." Christian Science practice is the demonstration of immortal truth over mortal error, which can only be accomplished through having the Mind of Christ, the divine Mind. The human mind is not a factor in Christian Science healing.

Yours, etc.,
CHARLES W. J. TENNANT.

CHRISTIAN SCIENCE COMMITTEE ON PUBLICATION,
TALBOT HOUSE,
ARUNDEL STREET,
STRAND, W.C.2.
December 1, 1921.

To the Editor of DISCOVERY

SIR,

My reference to Christian Science in my article was concerned with it in its aspect as a therapeutic system, and not with the metaphysical background of that system. I made the assumption that such success as it had in healing was due to its effectiveness as a process of suggestion to persons with a certain type of mind. A Christian Scientist will probably not agree with me in believing that Christian Science healing is purely an effect of suggestion, but that does not justify him in characterising my reference to it as *misleading*.

I am not one of those who hold that positive science certainly has the last word to say on such subjects, so I am willing to admit the theoretical possibility that the Christian Scientist may be right in supposing that there is an element in Christian Science healing which is not suggestion. . . . On the other hand, there is no scientific evidence that this is the case. What we do know is that there is a curative process of suggestion which is sufficient to account for Christian Science cures, that the deliberate use of this process (as at the New Nancy clinic) results in the cure of bodily ailments, and that the theory and practice of Christian Science are such as to put that process into operation amongst persons who accept the initial creed of Christian Science, including the formula (or dogma), "There is no disease." An elementary principle of science and of common sense forbids us to make the unnecessary hypothesis of a supernatural explanation for facts which have a sufficient explanation in known and natural causes.

Mr. Tennant's statement that "the human mind is not a factor in Christian Science healing" is sheer dogmatism. It is natural that Christian Scientists should suppose that it is not the *only* factor. But even that much less absolute statement cannot be accepted by those of us who are not Christian Scientists unless much more cogent evidence is brought forward than the mere unsupported assertion of believers in Christian Science.

Yours, etc.,
R. H. THOULESS.

MANCHESTER.
December 6, 1921.

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Editorial Notes

The presidential address delivered at the general meeting of the Classical Association held early in January was a fine summary of what both scholars and scientists have lately come to see more clearly than was the case not long ago, namely, that there is no essential antagonism between science and the classics, and that their combination in education is fruitful of the best results. We feel that Lord Milner expressed what is a steadily growing belief amongst our leading men of intellect when he said that "all modern science had its roots in the classics, and, on the other hand, no man imbued with the spirit of the great classical writers could be lacking in respect for science or fail to recognise its supreme importance to the progress of mankind." Another, and to our mind extremely important, point in Lord Milner's address—important because of its bearing on the present international problems—was his insistence on the vast share of Greece and Rome in the fabric of European civilisation.

* * * * *

With regard to Lord Milner's first point, this can be illustrated simply enough. We know, of course, that the Babylonians and Egyptians possessed rudimentary mathematical ideas, but it was the Greeks who after the early sixth century B.C., when Thales, the geometrist and astronomer, returned from Egypt, developed those ideas into a complex theoretical as well as practical science. Again, no modern student of Natural Science will deny his debt to Aristotle, and doctors recognise that the main origins of their art spring from the writings of Hippocrates, who lived in the fifth century B.C. These are merely a few obvious examples. For a full account by well-known scientific and scholastic experts of the extent of our debt to the early Greek "scientists," we refer our readers to a recently published book, *The Legacy of Greece*.[1] To appreciate the stupendous achievement of the Greeks, we need to take a bird's-eye view of the world's history. Man had existed on the earth for several million years before their appearance. He had existed, sometimes as in Egypt, with a certain degree of nebulous questioning as to his existence that resulted in fantastic religions; but on the whole, existence without too much questioning had been sufficient for him. Now the Greeks started to probe the problem of existence very thoroughly, and from what knowledge they possessed to formulate and test theories about the origin of life, the soul, the earth, the heavens, etc. In their resultant discussions and writings they laid the foundations of what we moderns call "science."

* * * * *

This questioning spirit of the Greeks laid not only the foundations of science, but of Western civilisation. Let us for the moment still keep our bird's-eye view. As Professor Gilbert Murray[2] has lately pointed out: "In the total age of the world or of man the two thousand odd years between us and Pericles do not count for much. . . . Yet in a sense the world was young then, at any rate our Western world, the world of progress and humanity. For the beginnings of nearly all the great things that progressive minds now care for were then being laid in Greece." That is just it. Our vaunted "civilisation," which has marked Europe and modern America from the

[1] Edited by R. W. Livingstone and published by the Clarendon Press, Oxford, 1921, 7*s.* 6*d.*

[2] In his introductory contribution to *The Legacy of Greece* on *The Value of Greece to the Future of the World.*

rest of the world, is little over 2,000 years old—2,000 years, a mere fraction of the several million years during which man has inhabited this earth. And it was started in a small peninsula broken up by mountains and sea into numerous little warfaring states.

* * * * *

But it is doubtful if the Greek spirit would ever have permeated Europe except for the powerful consolidation it received at the hands of Rome and of Christianity. Truth, Beauty, Freedom—above all the last in the fullest meaning of the word—these were the teachings of Greece. But "freedom, as we know it, is the fruit of the training of Western Europe for many centuries in Greek ideas, conveyed first through Roman channels. . . ." I take these words from a recent book by Professor Conway,[1] who has shown in the most enlightening manner the share of the Roman Empire in moulding Western civilisation, and in engrafting into it the idea of justice and free government. As Professor Conway points out in the final chapter in his book, it was mainly the Roman idea of municipal government that saved Europe from complete chaos in the Dark Ages, and was a potent influence in its subsequent rebirth.

* * * * *

We have intentionally concerned ourselves with the Græco-Roman elements in our civilisation, and with the debt that we owe to them. We acknowledge at once, without going further into the matter, the vast contribution of Christianity. Lord Milner said towards the end of his presidential address: "Among the factors which for many generations have made most powerfully for the maintenance of some measure of moral unity among European nations, Christianity and Græco-Roman culture stand out pre-eminent."

* * * * *

We are entering a new era of civilisation, in which the idea of internationalism is going to play a big part. There is a tendency amongst extremists to think that the elements of European civilisation, of which we have spoken, are outworn and are likely to be discarded in this new era. We believe that this is not the case. One of the most remarkable signs of the times is the way in which Oriental nations are co-operating with Western civilisation—in the League of Nations, at the Washington Conference, and elsewhere. To what end? Surely, on the whole, for justice, freedom and order as against slavery, treachery, and chaos. And these, taking the broader aspects of their history, are the very things for which our spiritual ancestors, the Greeks and Romans, fought and wrote and lived.

[1] *New Studies of a Great Inheritance.* (John Murray, 1921, *7s. 6d.*)

The eyes of the world are at the present moment fixed scrutinisingly on Russia. We are constantly being told that Russia is an enigma, even to her own people, that no one can understand this people, since they do not understand even themselves. Yet, surely, the answer to the enigma is that Russia, while the rest of Europe was being impregnated by Roman colonisation, lay under the domination of the Mongols; that within her vast frontiers the ideals and races of the East and West have been in continuous conflict. Such at least is the answer to which any thinking person who has read the great Russian novelists, or listened to Russian music, or watched the Russian ballet, is instinctively driven. In the individual souls of these people, cruelty and kindness, uncontrolled passions and high ideals, energy and laziness, are always trying to get the upper hand of one another. Lately we have seen them break up a terrible régime of oppression only to replace it by one of far greater tyranny and cruelty.

* * * * *

But the fight that has been for many centuries, and is still being, waged at a far intenser pitch in Russia, is symptomatic of the fight that is going on all over the world. It is the fight of Western civilisation against slavery, treachery, and chaos. No one who has lived long amongst Oriental peoples will deny that they have much to teach the world, but no one better than he realises the value of the Westerner's attitude to life and humanity. As we have already remarked, we believe that the East on its side is beginning to appreciate many of the teachings of Western civilisation. This is not the juncture in the world's affairs for the people of Europe to discard in education or in aught else the bases themselves of that civilisation.

* * * * *

From time to time there appears in the daily Press a sensational claim that gold can be made by artificial means. No less than three of these claims were made last year, and altogether about a dozen have been put forward in widely different parts of the world during the past twenty years. There is a great similarity about these claims. The claim is always put forward by someone who is quite unknown in the scientific world, and it is a curious mixture of current scientific theories, of experiments that might conceivably be carried out, of a certain amount of palpable error and of a good deal of nonsense. For a short period each claim occupies a place in the conversation of educated persons; a few distinguished scientists are interviewed by the newspapers; a few economists and others express their opinions, but nothing ever happens and soon the subject drops.

* * * * *

It may be said at once that this talk about making

"synthetic gold" is nonsense. It is not nonsense like the popular superstition that Hector Macdonald or Lord Kitchener is still alive, for there is no possibility that either of these men is alive, and there is a possibility that gold may some day be made from other materials. But it is nonsense because in fact no one has ever made gold artificially. Men who claim that they have done so have not done so. They have really done nothing but assert that a process, which the careful work of a few brilliant scientists has shown to be *possible*, is actually an accomplished fact. But there is a difference between a thing that is possible and a thing proved or done, and this difference may be very great.

* * * * *

The two scientific ideas underlying the process of making gold artificially are these. First, there is evidence in nature, obtained partly from physics and partly from astronomy, that the heavier elements have been, and are being, built up in some way upon lighter ones ; that the elements are not fundamentally different, as was thought thirty years ago, but are merely different aggregations of a very special kind. The second is that the discoveries in radio-activity (1899–1903) revealed the spontaneous transformation of certain heavy elements into lighter ones. Both of these are important and illuminating ideas. The first suggests that elements may be formed by synthesis, i.e. by building up from simpler forms ; the second, by degradation or breaking down from more complex. But these are natural processes, and research into their nature has so recently been begun that we are not yet able to imitate them. How or why they occur is yet a mystery. We know little about them save that they exist.

* * * * *

Of the two processes, that of disintegration or breaking down would at first sight appear to be the more hopeful, for it is common experience that to smash to pieces a delicate mechanism is easier than to accomplish successfully the reverse process ; and on pursuing the matter more deeply this view is found to be justified. The building up of elements, which is supposed to be going on in the Universe, cannot be properly studied in a laboratory ; radio-activity can, and so it is that from this science alone the meagre existing evidence concerning transmutation has been obtained. Part of this evidence is negative, part positive. The negative evidence is that high temperatures and great pressures (by which, for example, carbon or graphite may be converted into diamonds), have no effect whatever in transforming one element into another ; the positive is that certain of the lighter elements, when bombarded by atoms of helium, shot out at great speeds by preparations of radium, do break down into simpler forms, one of which is certainly the element hydrogen. The enormous difficulties which this process, the only known method of effecting artificial transmutation, involves, have already been mentioned in an article in this journal.[1] No more need be said here than two things : there appears to be little hope that the process can be so extended that common metals like bismuth, lead, or mercury will be transmuted by disintegration into weighable quantities of rarer metals like gold and platinum, and none that this will be effected on a commercial scale. Second, if a new process be found, or the present one be extended, it will be the work of someone who is "inside" this extremely technical piece of research work ; it will not be accidentally found by an unknown man.

Contributors to this Number

Lieut.-Col. C. G. Crawley holds the position of Deputy-Inspector of Wireless Telegraphy in the General Post Office, and also that of Secretary of the Technical Commission which is planning the Imperial Chain of Wireless Stations. He entered the service of the Post Office in 1913 after ten years' employment in the Navy as Experimenter, Instructioner, and Fleet Wireless Officer. He returned to the Naval wireless service for the period of the war, when he served as a wireless officer in the Grand Fleet, at the Admiralty, in command of the R.N.V.R. wireless school, and supervised the erection and working of various naval stations abroad.

Dr. Aylward M. Blackman, after studying Oriental languages at Oxford with high honours, devoted himself to Egyptology. From 1906 to 1912 he was constantly employed on archæological expeditions in Nubia and Egypt, and, as the result of his researches, has made extensive contributions to the literature of his subject. In 1912 he took on the work of the Archæological Survey of the Egypt Exploration Society, in order to publish the very important Old and Middle Kingdom tomb-chapels at Meir, near Asyūt, on which he has so far produced three volumes. He resumed work on the site last year.

The Rev. Hector Macpherson had a most successful career at Edinburgh University, and at New College, Edinburgh, where he was Waterlock Prizeman and Cunningham Fellow. He has carried through extensive investigations on the distribution of the stars, and on the moon and planets. He is the author of articles in many scientific journals, and of several volumes, including *A Century's Progress in Astronomy*, *Through the Depths of Space*, and *Practical Astronomy*.

Mr. Julian Huxley gained a scholarship at Balliol College, Oxford, in 1906, first-class honours in National Science and the Naples scholarship in 1909, a "blue" for the high jump and the Newdigate Prize for English verse. He was appointed a Fellow of New College, and Senior Demonstrator in the Department of Comparative Anatomy, Oxford University, in 1919, and is the author of *The Individual in the Animal Kingdom*, and a well-known contributor to scientific and literary papers.

Thomas Moult is one of the most versatile of the younger English authors. *Snow over Elden*, his first novel, was published in 1920, *Down Here the Hawthorn* (poems) in 1921. He is the founder and editor of *Voices*, a magazine of the arts, now in its fourth year. He has contributed extensively to our leading literary journals.

Dr. J. Travis Jenkins was appointed Professor of Zoology at Hartley University College, Southampton, in 1903, and Superintendent of Fisheries for the Lancashire and Western Sea Fisheries Committee in 1904. He was called to the Bar in 1907. Thereafter he undertook official investigations of Indian fisheries, resuming his Lancashire appointment in 1911. He is the author of *Sea Fisheries*, a textbook of oceanography, and *A History of the Whale Fisheries*.

[1] Discovery, vol. ii, p. 200.

Directional Wireless

By Lieut.-Col. C. G. Crawley, R.M.A., M.I.E.E.[1]

As a rule, at small wireless stations, such as those for communication with ships and those in the ships themselves, no attempt is made to obtain any directive effects, that is to say, the waves from the sending station are radiated in all directions, and at the receiving station waves can be received equally well from all directions.

For the ordinary purposes of communication between ships, and between ships and shore stations, it is indeed essential that all-round signalling should be the normal

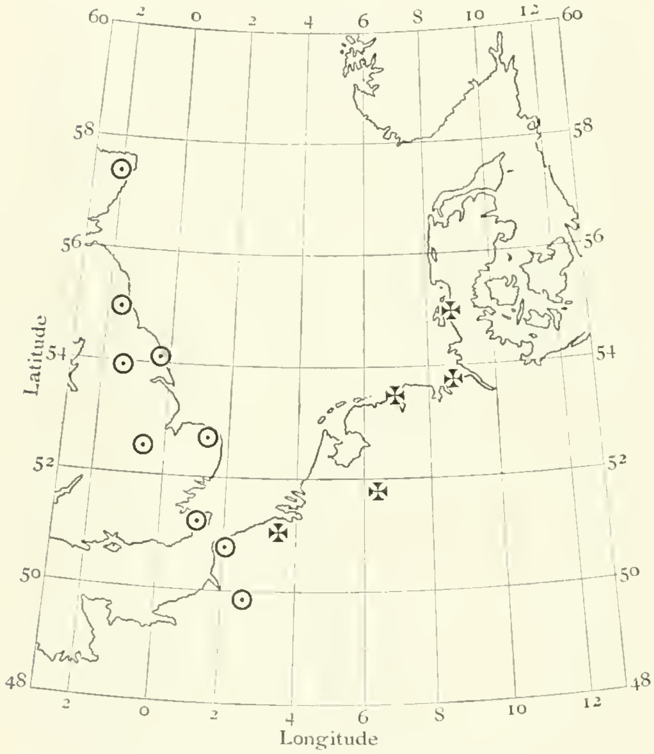

FIG. 1.—BRITISH AND GERMAN DIRECTIONAL WIRELESS STATIONS.

arrangement, so that a distress signal from a ship will be heard by all ships and stations within range, irrespective of direction; but it may often happen, especially in the case of ships and aircraft, that an indication of the direction from which signals are being received will be of great value. This fact was grasped very early in the war by the Air Forces on both sides, and directional apparatus for navigational purposes was rapidly developed, and extensively used, in military aircraft. For ships, on the other hand, the development ran on another line, that of locating enemy ships, which were using wireless, by means of direction-finding shore stations, and stations used for this purpose by both sides round the North Sea are shown in Fig. 1. These stations, at any rate those on our side, did excellent work in obtaining timely information on many occasions of the movements of enemy craft, both ships (including submarines) and aircraft. The most famous occasion was that leading up to the Battle of Jutland. This was well told at a meeting of the Institution of Electrical Engineers by Admiral of the Fleet Sir Henry Jackson in the following words: "We have heard much about the use of direction-finding for minor tactical movements of all arms, but this is a case of a major strategical operation which brought about the historical meeting of the British and German Fleets at the Battle of Jutland on May 31, 1916. I was First Sea Lord at the time, and so was responsible for the disposition of the Grand Fleet. I may incidentally mention that, in spite of other statements of which I have heard, its Commander-in-Chief (Lord Jellicoe) and I lived, so to speak, with the object of bringing off such a meeting. Our wireless direction-finding stations, under Captain Round, kept careful and very intelligent watch on the positions of German ships using wireless, and on May 30, 1916, heard an unusual amount of wireless signals from one of the enemy ships which they located at Wilhelmshaven. This was reported to me; the time was a critical and anxious one in the war, and I had also some reasons for expecting that the German Fleet might put out to sea during the week. Our Fleet was ready at short notice and had arranged, unless otherwise prevented, to put to sea on the following day for a sweep of the North Sea. But if the German Fleet got to sea first, the chance of a meeting in waters not unfavourable to us was remote; our object was to try to get to sea before or shortly after the Germans, and hitherto we had not succeeded in doing so. Later on in the afternoon, it was reported to me that the German ship conducting the wireless had changed her position a few miles to the northward. Evidently she and her consorts had left the basins at Wilhelmshaven and had taken up a position in the Jade River ready to put to sea. This movement decided me to send our Grand Fleet to sea, and move towards the German Bight at once and try to meet the German Fleet and bring it to action. This they did with their usual promptitude, and the result was the famous Battle of Jutland, and it was indirectly brought about by the careful and accurate work of Captain Round and his staff, for which I hope they will now accept my belated thanks and appreciation. Their work is not ended. Direction-finding has come to stay for more general use in peace. Errors are being eliminated, and there should be a great future before it, especially on the lines

indicated in the Press to-day by the Admiralty for assisting navigation at sea as well as in the air."

It will be gathered from Admiral Jackson's closing remarks that some of the war-time direction-finding stations are still being used ; but for the more peaceful purpose of assisting in the navigation of ships and aircraft. The stations were not used for that purpose to any great extent in the war, though directional sets fitted on aircraft were used pretty frequently for navigational purposes by obtaining bearings from known fixed land stations.

At first sight, it would appear that directional receiving sets in ships or aircraft would be invaluable for obtaining bearings from land stations, and so they would be if the results obtained were always reliable. There are, however, errors which are liable to arise from various causes, some of which are not yet fully understood, and cannot therefore be allowed for. The most serious of these arise from bendings of the paths of the waves by reflection and refraction due to certain states of the atmosphere ; for instance, observations may be made at, say, 100 miles, within an accuracy of 1 degree on nineteen days out of twenty, but on the twentieth day there may be an error of as much as, say, 5 degrees, due to some bending effect on the path of the waves taking place between the sending and receiving stations. There are also possibilities of local errors due to the effects of metal-work, such as stays for masts, etc., at the receiving station, as well as bending effects on the waves due to the proximity of cliffs, or long coast-lines in the path of the waves. These local errors, since their causes are better understood, can be eliminated, or corrected, sufficiently for all practical purposes, but it is clear that, at the best, the bearings given by wireless directional methods cannot yet be looked on as thoroughly reliable. The point is, however, that they are sufficiently reliable to be very useful when it is impossible to take observations by other means, due to, say, thick or foggy weather.

We might now examine briefly the principles underlying directional wireless, and in doing so let us first recall the usual non-directional arrangement. At the transmitting station, wireless waves are radiated in all directions by oscillatory electric currents flowing in an elevated system of wires, called the aerial or antenna, which in its simplest form, and that first used, consists of a single vertical wire. At the receiving station these waves produce similar, though much weaker, currents in the receiving aerial, which in its simplest form consists also of a single vertical wire, and there is no directional effect ; that is to say, the direction from which the waves are coming has no effect on the strength of the signals received. As soon, however, as the aerial is bent or sloped out of the vertical, so does it become better for sending to, or for receiving from, one direction more than any other. This effect was foreshadowed in Hertz's original experiments in Germany in 1887, but was not made much practical use of until 1905, when Marconi commenced to use an inverted L-shaped aerial for transmission and reception. Such aerials transmit best to, and receive best from, the direction opposite to that towards which the horizontal portion stretches, but the effect is not very strongly marked. Aerials of this description are used at many high-power stations, so that the greatest possible radiation is directed towards the receiving stations.

Another form of directional aerial which is very extensively used, especially for receiving stations, consists of a vertical rectangular loop which best receives waves travelling in the direction of the base of the rectangle. Signals from any other direction are weaker, until in the line at right angles to the best direction no signals are heard.

This effect can be easily seen from a consideration of Fig. 2, where A and B are two vertical wires, and R

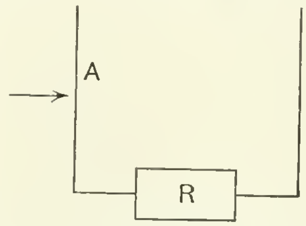

Fig. 2.—Rectangular Loop Aerial.

is the receiving apparatus. If the waves are coming from the direction shown by the arrow, or in the exactly opposite direction, their effect on A will not be the same, at the same moment, as their effect on B, and some current will flow through the receiver. If, however, the waves are coming in a direction at right angles to this, i.e. through the paper, they do produce the same effects in A and B at the same moment, and no effect is produced in R. This is clear if one considers the moment when the waves produce currents of the same strength flowing down A and B simultaneously, as then, so far as R is concerned, these currents cancel one another and produce no effect. This arrangement of directional aerials was first introduced by S. G. Brown in this country in 1899. The Italians, Bellini and Tosi, used triangular loop aerials, as in Fig. 3, at right angles to one another, in conjunction with a special receiving circuit, in which a coil is revolved by hand until signals become loudest, when a pointer attached to the coil indicates on a scale the direction from which the signals are being received. As a matter of fact, greater accuracy is obtained by noting when the coil is in the position

where signals become inaudible, or by introducing another coil into the circuit and noting when its introduction has no effect on the strength of signals, but these are technical details which need not be considered here. This Bellini-Tosi arrangement was used for several years before the war, but was not fully developed until, during the war, the introduction of the three-electrode thermionic tube as an amplifier of weak signals completely revolutionised wireless reception, and made it possible to employ small loop aerials for the reception of signals transmitted from even great distances. Small loops are now extensively used for direction-finding purposes in aircraft, and larger ones in ships. The adoption of this apparatus in ships is not so general as in aircraft, but a few score of our merchant ships are already fitted. The possible errors already mentioned largely account for this comparatively slow growth, as well as the fact that directional shore stations can give more accurate

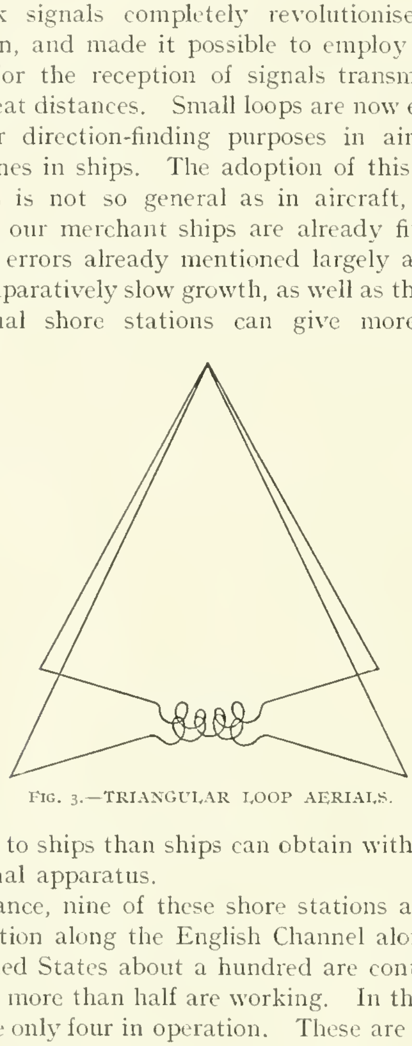

Fig. 3.—Triangular loop aerials.

bearings to ships than ships can obtain with their own directional apparatus.

In France, nine of these shore stations are already in operation along the English Channel alone, and in the United States about a hundred are contemplated, of which more than half are working. In this country there are only four in operation. These are at present under Admiralty control, but as has recently been announced in the Press, it is intended to transfer this work to the Post Office, the department responsible for our commercial wireless communications. In shore stations greater accuracy is obtained than in ships, as there are less obstructions to the path of the waves in the form of masts, stays, etc., and more highly trained operators, as well as conveniences in the matter of space, quietness, and stability, are available.

A ship or aircraft fitted with directional apparatus can obtain a bearing relative to its fore and aft line from any wireless station which it hears transmitting, and by taking such bearings from two, or preferably three, stations, it can obtain its position, usually to a degree of accuracy sufficient for the purposes of navigation when other means have failed, provided that the stations happen to be suitably placed for obtaining a good cut with the lines of bearing. For distances up to about 100 miles the bearings can be plotted on the usual Mercator's chart, but for greater distances a chart on the gnomonic projection must be used. In these gnomonic charts, great circles appear as straight lines instead of curves as in Mercator charts, and the necessity of using the gnomonic projection for long ranges is evident when it is remembered that wireless waves travel along great circles over the surface of the earth. As a matter of fact, in ship work, bearings from stations at distances of over 100 miles are very seldom required, so that the usual Mercator chart gives sufficiently accurate results under favourable conditions; but, as mentioned above, the results obtained by ship sets are not so reliable as those obtained by direction-finding shore stations. In the latter case, the ship, which does not require any directional set of its own, calls up a station and asks for its bearing. The ship then transmits a succession of letters, the station takes the bearing and signals it to the ship. Sometimes two or more stations work in conjunction; each takes a bearing, and the controlling station then signals to the ship the position which is obtained from the bearings taken. It will be noticed that when shore stations do the work, the responsibility for the results rests with them, not with the ship, as would be a more satisfactory arrangement if the results obtained by ships were as reliable as those obtained by shore stations. In this country, a charge of five shillings is made for a bearing given by a direction-finding shore station, and similar charges are in contemplation, or are already made, in several other countries.

The "radiophare," or wireless lighthouse, is another form of directional shore station, and some of these are in operation in France and the United States, but not in this country. A radiophare is a directional transmitting station which sends out continuously a beam of wireless waves in a certain direction, strong enough to be received by a ship up to a range of, say, thirty miles. The transmission consists of the call signal of the station sent continuously, so that when a ship is receiving this signal it knows that it must be somewhere in the beam sent out by that particular station, and details are published of the direction of the beam sent out by each radiophare. This form of station is being found useful for navigational purposes during fog in narrow waters, such as river mouths and channels.

Directional receiving stations are now coming into extensive use for another quite different purpose, viz. commercial long-range point-to-point communication. Three conditions are required for a paying commercial long-range service; first, high-speed signalling; secondly, duplex working; thirdly, freedom from interference, and of these the second and third can be obtained, to a great extent, by receiving the messages at a directional receiving station separated from its sending station. This arrangement is now made for practically all long-range services throughout the world. In duplex working, messages are sent and received at the same time, the receiving station being some miles distant from its sending station, and arranged directively, so that it can receive from the distant station without being interfered with by the transmission of telegrams from its own sending station. Similarly, freedom from interference from other stations is materially assisted by the fact that the receiving station, being directional, can only receive well on the line, or prolongation of the line, between it and the distant station from which it wishes to receive, so that sending stations situated in other directions will not interfere. Owing to the great amplification in the strength of the current at receiving stations made possible by the use of thermionic tubes, quite small loops consisting of a number of turns of wire wound on rectangular frames, about eight feet square, are now the only aerials used at many of the high-power stations in Europe for receiving commercial messages from stations at great distances such as those in the United States of America.

A New Chapter in the History of Egyptian Art

By Aylward M. Blackman, D.Litt.

About 200 miles south of Cairo on the west bank of the Nile in the province of Asyūṭ lies the town of Ḳuṣīyeh, the Cusæ of antiquity. Once the capital of the fourteenth nome or province of Upper Egypt, it has, in the course of centuries, dwindled into a place of small dimensions and third-rate importance. In the western desert, distant about a two and a half hours' ride from Ḳuṣīyeh, is to be found the ancient necropolis of that erstwhile famous city. It consists of an extensive chain of cemeteries, occupying not only a considerable stretch of the inner or western side of the lower desert, but climbing half-way up the steep limestone slope which terminates in the high desert plateau—the great and mysterious Sahara. To the whole of this ancient site the not far distant village of Meir has given its name.

*

The poorer inhabitants of Cusæ, like the local *fellāḥīn* (peasants) of to-day,[1] buried their dead in the lower desert. The high desert slope is honeycombed with the burial-pits of the wealthier citizens, and here also are excavated the tomb-chapels of the great feudal lords or nomarchs of Cusæ, who flourished from about 2920 to 1900 B.C.[2] It is with the reliefs and paintings decorating the walls of some of these chapels that the present article is concerned.

Not till well on in the Fifth Dynasty, about 3050 B.C., when, owing to the weakening of the centralising power of the Memphite or Old Kingdom Pharaohs, the feudal system had pretty fully developed, did the provincial governors start to construct their funerary chapels near their respective seats of government. Hitherto they had been so closely attached to the court and person of the sovereign, to whom they owed their positions, that they had always been buried near his pyramid, which was regularly erected in the neighbourhood of the capital. By the beginning of the Sixth Dynasty, about 2920 B.C., these governors, who in the first instance had been appointed by the king and exercised their religious and civil functions solely as his representatives, had become feudal barons, each firmly entrenched in his own domain and ruling over it by right of inheritance—though to be sure, when a son succeeded his father, the succession had anyhow in theory to be ratified by the Pharaoh. To this last-named period, the Sixth Dynasty (*circa* 2920 to 2720 B.C.), must be assigned the earliest sculptured and painted tomb-chapels of the Cusite nomarchs at Meir, for the decoration of which the local craftsmen employed the same subjects, and rendered them in the same manner, as the court artists at Memphis who adorned the royal funerary temples and the tomb-chapels of the nobles, still to be seen at Saḳḳāreh, Gīzeh, and Meidūm. Both the subjects and the manner of rendering them had been stereotyped for centuries, and the same scenes and groups of figures were reproduced over and over again by the Old Kingdom craftsmen with very little variety. The only difference between the work of the court and provincial artists is that the latter did not make use of such a variety of subjects as the former, while their workmanship is decidedly rougher and clumsier.

After the fall of the Sixth Dynasty the feudal lords seem to have contented themselves with undecorated tomb-chapels; anyhow, none of Old Kingdom date at

[1] See W. S. Blackman, "Some Modern Egyptian Graveside Ceremonies," in Discovery, vol. ii, pp. 207 foll.

[2] In accordance with the revised dating of Dr. Ludwig Borchardt in his work, *Die Annalen und die Zeitliche Festlegung des alten Reiches der ägyptischen Geschichte*, Berlin, 1917.

Meir can be assigned to a time later than the end of the reign of Piōpi II, about 2720 B.C. From then onwards until the Eleventh Dynasty, about 2040 B.C., with which began the Middle Kingdom, the scenes, hitherto represented in reliefs or frescoes on the walls of the funerary chapels, were reproduced in the form of wooden models—some of them being of beautiful workmanship—which were placed along with the mummy in the subterranean burial-chamber.

With the advent of the Twelfth, or perhaps rather towards the end of the Eleventh, Dynasty, the Cusite barons again began to have their tomb-chapels adorned with painted reliefs, these reliefs being of a very remarkable character. In the interval between the Sixth and Eleventh to Twelfth Dynasties a new and local school of art seems to have grown up at Cusæ. The artists who executed the reliefs in the earlier Middle Kingdom tomb-chapels at Meir, those of Senbi and his son Ukhḥotpe, had broken away to a very great extent from the artistic traditions and conventions of the Old Kingdom or Memphite school, and had developed a style of their own which is characterised by its remarkable freedom, especially in the treatment of the human form.

It is not in the choice of subjects, but in the rendering of them, that the early Middle Kingdom art of Cusæ differs from the traditional art of Memphis. The Cusite artists, indeed, still employed the same stock scenes as are to be found on the walls of the *maṣṭabehs* [1] of Saḳḳāreh and Gīzeh, but they imbued them with a new vigour and carried them out with a freedom hitherto unknown. This break with old-established conventions, be it noted, is as a rule observable in the figures of persons of little social importance, such as herdsmen, fishermen, and the like, and in the representations of animals, not in the figures of the owner of the tomb-chapel or of his wife or yet of officiants engaged in performing strictly liturgical acts, all such being executed in the old traditional manner.

It is possible that this naturalistic art originated not among the craftsmen of Cusæ, but of Heracleopolis Magna, now called Ehnāsiyeh el-Medīneh, the seat of the central government during the Ninth and Tenth Dynasties, which lasted from about 2500 to 2220 B.C. Anyhow, it was certainly in that city that some of the finest literary works of ancient Egypt were produced, viz. the so-called *Eloquent Peasant*, *The Instruction which King Akhthoi made for his Son Merikrē'*, *The Admonitions of an Egyptian Sage*, and possibly also *The Dialogue with his Soul of One who is Weary of Life*—works of striking originality and of marked freedom in thought and style.

The new and free spirit which inspired the early Middle Kingdom artists of Cusæ makes itself strongly felt in a hunting scene in the tomb-chapel of Senbi (Fig. 1). In the choice and general arrangement of the various figures of animals it closely resembles other Egyptian hunting scenes, in particular that which once decorated one of the walls of the pyramid-temple of the Pharaoh Saḥurē' (Fifth Dynasty), and which is now preserved in the great Egyptian collection of the Berlin Museum. The Memphite sculptors of reliefs were distinctly more successful in depicting animals than in rendering the human form, and the animals in the last-mentioned scene give one a vivid impression of life and motion. But even in this respect the sculptors of Memphis have been surpassed by those of Cusæ. Neither in the Saḥurē' hunting relief, nor in the similar reliefs occurring in the Old Kingdom *maṣṭabehs* at Saḳḳāreh, Gīzeh, and Meidūm (see e.g. that in the *maṣṭabeh* of Ptaḥḥotpe [2]), is there anything quite as

FIG. 1.—HUNTING SCENE IN SENBI'S TOMB-CHAPEL.

[1] The tomb-chapels of the Old Kingdom nobles are so designated because in shape—they are rectangular flat-topped masses of masonry with sloping sides—they closely resemble the stone bench, *maṣṭabeh*, upon which the customers sit outside the open Arab shop. For an excellent representation of a group of *maṣṭabeh*-tombs see A. Erman, *Life in Ancient Egypt*, English translation by H. M. Tirard, London, 1894, p. 311.

[2] The *maṣṭabeh* or tomb-chapel of Ptaḥḥotpe, a high official of the Fifth Dynasty, contains some of the finest reliefs executed by the Old Kingdom Memphite sculptors (see J. E. Quibell, *The Ramesseum*, London, 1896 [out of print], and N. de G. Davies, *The Mastaba of Ptahhetep and Akhethetep at Saqqareh*, 2 parts, London, 1900–1901).

vigorous as the Cusite sculptor's representation of the lion's tussle with the bull. The lion has caught the bull by the muzzle, and they both pull one against the other for all they are worth ! It is a fine piece of realism, for a lion, when he attacks a bull, always *does* make for this part of him, so a big-game hunter tells me, it being the poor beast's most sensitive spot, and, when once he is grabbed there he is practically powerless. How full of life, too, are the fleeing hartebeests, antelopes, and gazelles, and the hounds who grapple with them and bring them down ! And surely it was the artist's deliberate intention to emphasise the difference between the slow gait of the hedgehog and the rapid flight of the hare when he placed them in such close proximity.

But the outstanding feature of the relief is the figure of the noble hunter himself. Every muscle is tense, and every nerve alert as he raises himself on the toes of his right foot and leans forward to discharge an arrow from his bow at the flying deer—the keen sportsman every inch of him. In no other ancient Egyptian hunting scene preserved to us is there to be found so lifelike or so vigorously posed a bowman.

The artist's break with tradition is all the more remarkable in that it is the figure of the owner of the tomb-chapel himself which has been treated in this way, a very unusual occurrence even at Meir. The only other instance in these tomb-chapels of such an unconventional rendering of the figure of an important personage is to be found in a relief in the adjacent tomb-chapel of Senbi's son Ukhḥotpe. That noble and his wife are there depicted being entertained by a party of musicians. He sits on a chair while she, squatting on the floor and lovingly clasping his leg, turns her face round and looks up with a smile into his face to see how he is being affected by the music and the no doubt highly emotional songs !

Other admirable examples of the naturalism of the Cusite artists occur in the tomb-chapel of Senbi,[1] for instance, the spirited representation of a bull being lassoed, a Bishāri herdsman with his oxen (cf. the very similar figure discussed below), and a fat old fisherman, who has just hoisted his heavily laden net out of the water.

Certain sculptures in the tomb-chapel of Senbi's son Ukhḥotpe are, so it is said by competent critics, to be reckoned among the greatest works of art that have survived to us from the ancient world. Take, for example, the old fellow leaning on a stick and conversing with a boatwright (Fig. 2). Pot-bellied, somewhat decrepit, and very garrulous, he is the type of old peasant that you may see any day in a modern Egyptian village. In the figures of the boatwrights, who continue their task quite regardless of the old man's idle chatter, the sculptor has produced a very lively bit of work. They really do seem to be tugging hard as they rope together the papyrus reeds out of which they are constructing a skiff.

FIG. 3.—TWO PAPYRUS-HARVESTERS. FIG. 2.—OLD MAN CONVERSING WITH A BOATWRIGHT.

Almost as great an achievement as the fat old gossip are the two *fellāḥīn* who are binding a great bundle of papyrus reeds, which have just been harvested (Fig. 3). Particularly fine is the right-hand figure, whose hard muscles rippling beneath his soft skin are splendidly indicated, and who, it will be noted, is depicted in proper profile. He is the typical hulking Upper Egyptian yokel, the standing joke of the "urbane" town-bred clerk who haunts the coffee-house. Rather coarse-featured though he be, he is a good-natured

[1] Reproductions of these will be found in *Rock Tombs of Meir*, vol. i, pls. iii, x, xi, xxi, xxv, xxviii and xxx. Vide Bibliography at end of article.

fellow, always responding to a joke and always ready to take on any job demanding the exercise of physical strength, for that he possesses in abundance, and is only too proud and pleased to display it.

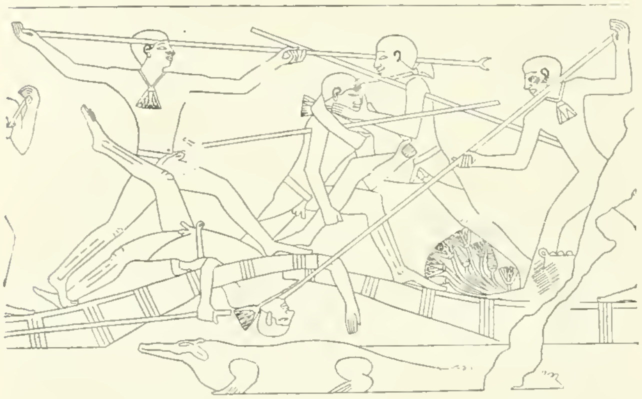

FIG. 4.—FIGHT BETWEEN TWO BOAT-CREWS.

The famous Italian sculptor Zanelli waxed enthusiastic over the Meir reliefs, and in particular, I think, over that depicting the fight between two boat-crews (Fig. 4). He delightedly drew my attention to the man who has fallen down, and whom one of the crew of the rival boat is jabbing in the throat with a punt-pole. The artist, Zanelli pointed out, has most brilliantly caught off the poor fellow's attitude at the very moment after he had tumbled into that unenviable position, for the muscles and sinews of the right leg and foot are still strained in the vain effort to recover the lost balance.

But perhaps the most outstanding example of the realism of the Cusite artists is the representation of the Bishāri herdsman (Fig. 5). He is leading along three oxen and for a staff holds the branch of a tree off which the twigs have been roughly lopped. About his loins hangs what looks like a piece of gazelle's skin, his sole garment. The body is shown in actual profile, not turned round full-face upon profile legs. He is the typical Hamite, and the sculptor has most cleverly reproduced all the facial and bodily characteristics of an old man of that race—a long nose, scanty tuft-beard and almost hairless upper lip, a scraggy neck, bony chest and shoulders and sinewy arms and legs. His head is crowned with a mass of tangled hair, in which respect he presents a marked contrast to the Egyptian, whose head was clean shaven or else closely cropped. That what has been said about the realism of the Cusite artists is not an exaggeration is clearly shown by a comparison of this relief with the adjacent photograph of a painting of a modern Bishāri (Fig. 6), made by my friend, Mr. F. F. Ogilvie, at Aswān, in 1914. This Bishāri of Aswān might be our old friend at Meir come to life again, the chief difference being that the one wears a little more clothing than the other. But all the physical peculiarities, also the very stick that each carries, are similar! Taken together the ancient relief and modern painting wonderfully illustrate how racial characteristics survive unchanged through the ages.

Ukhḥotpe was succeeded first by a noble of the same name, possibly his nephew, and then by his son Senbi, both of whom, it would appear, administered the affairs of the province for a very short time. The son's tomb-chapel was never completed, and the scanty decoration both of it and of the insignificant chapel of his immediate predecessor is in the ordinary conventional style of the period.

The next nomarch, another Ukhḥotpe, had excavated for himself a large tomb-chapel decorated with brilliantly coloured, for the most part plaster, reliefs. These are of the finest possible technique, the smallest details being inserted with infinite care by paint-brush or engraver's point. However, they display none of the naturalism which characterises the work of the early Twelfth Dynasty craftsmen of Cusæ, and they are executed in accordance with the ordinary canons of the official art, closely resembling the painted reliefs which are to be seen in the tomb-chapels of the lords of the Hare-nome [1] at El-Bersheh. On the lintel of one of the doorways in this Ukhḥotpe's tomb-chapel are inscribed the cartouches of Amenemmes II, the third king of the Twelfth Dynasty, who reigned about 1935–1903 B.C. This occurrence of the royal names—no cartouches are to be seen in any other Twelfth Dynasty

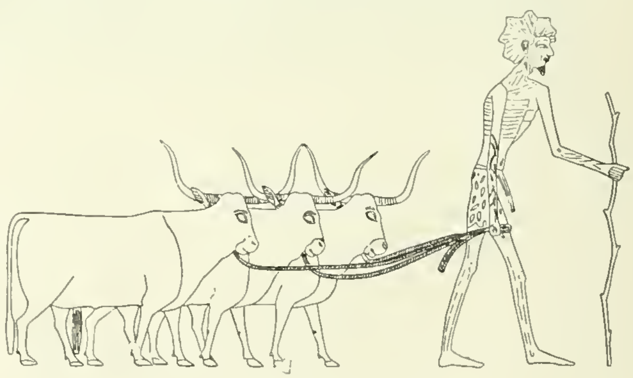

FIG. 5.—BISHĀRI HERDSMAN.

tomb-chapel at Meir—and the fact, as certain of his titles show, that the nomarch in question was the

[1] I.e. the fifteenth nome of Upper Egypt. Every nome or province had its distinguishing heraldic emblem or badge, mounted upon a pole and thus carried as a standard. These emblems consist as a rule of some animal or plant, occasionally of some inanimate object or objects such as weapons of war. They probably represent the original local fetish or divinity of the primitive inhabitants of each of these districts, subsequently supplanted by a later intrusive divinity, the nome-divinity of historic times.

keeper of the pharaonic[1] diadems, indicate that he was more closely associated with, and perhaps more subservient to, the king than the previous Cusite barons of this period. The style of the reliefs in his tomb-chapel certainly suggests the influence of the court; indeed it is quite possible that they are actually the work of court artists.

The next and latest of the decorated Middle Kingdom tomb-chapels at Meir, that of yet a fourth Ukhḥotpe—son of Ukhḥotpe and Ḥeni the Middle—probably dates from the reign of Amenemmes II's successor, Sesostris II, under whom the power and magnificence of the feudal barons reached their culminating point. The influence of the court, so noticeable in the tomb-chapel of his predecessor, is conspicuously wanting in that of Ukhḥotpe IV. Everywhere are indications that local artists were employed, but artists whose style is completely different from that of the men who worked for the earlier Twelfth Dynasty barons of Cusæ. In the first place, coloured reliefs have been replaced by paintings *in tempera*. Secondly, instead of the naturalism and at the same time simplicity of the older Cusite art, we are confronted with a flamboyancy[2] combined with a display of affectation and mannerisms hitherto unknown in Egyptian art

Fig. 6.—A modern Bishāri from Aswān.
(*Photograph of a painting by F. F. Ogilvie in the possession of the author.*)

of any period. "Precious" is the adjective that best describes these certainly very attractive, if somewhat decadent, frescoes, which well reflect the luxury and fastidious tastes of the governing classes of that time.

Fig. 7.—Thin-waisted young men carrying offerings.

The affectation and mannerisms in question are very conspicuous in the pair of young men, unhappily much defaced, shown in the adjacent cut (Fig. 7). They wear finikin bead necklaces quite unlike the ordinary Egyptian man's broad bead-collar, and, what is a most unusual feature, each has a long pigtail, with a curl at the end, hanging from the back of his head. They are painted pale yellow like the women, not the wholesome reddish brown of the ordinary Egyptian man; and, be it observed, *all* the men in these particular frescoes, farm-hands, fishermen, and agricultural labourers, are given this same effeminate colouring. In addition they all present the same physical peculiarities that are noticeable in the accompanying illustration—full developed breasts, thin waists, and rather broad hips. There is but one exception to this rule, the owner of the tomb-chapel himself, who is rather a burly fellow of the normal Egyptian build and with the ordinary dark complexion.

Is it a mere coincidence that all the chief monuments testifying to another and much later naturalistic movement in Egyptian art, a movement characterised by its disregard for accepted traditions, and by its unconventionalism, are to be found in this neighbourhood, namely, at El-Amarna, which is not twenty miles north of Cusæ? Outstanding features of the El-Amarna reliefs[3] and paintings are the broad hips, slender waists, and full-developed breasts of the men, which, it has always been maintained, were peculiarities of King Akhenaton's own person, and were, out of respect for him, assigned by the court artists to all his nobles and attendants in their representations of them. Now, as we have seen, very similar peculiarities in the rendering of the male form are to be observed in the frescoes adorning what I have pointed out is the latest of the decorated Twelfth Dynasty tomb-chapels

[1] The royal diadems, the White Crown of Upper, and the Red Crown of Lower, Egypt, were very sacred objects. Indeed, they were regarded as divinities, the embodiments of Nekhbet and Uto, who were the tutelary goddesses of Upper and Lower Egypt respectively. Hence he to whose custody these crowns were committed was not merely their keeper, but also their priest.

[2] Particularly in certain fishing and fowling scenes.

[3] For an account of the art and religion of El-Amarna see Professor Peet's article in Discovery, vol. ii, pp. 252 foll.

at Meir. I would, therefore, make bold to suggest that the "new" art which we have been accustomed to consider a special development of the reign of Akhenaton, resulting from a change in religious beliefs and a consequent abandonment of old conventions, is really due to the fact that when the "heretic king" transferred the capital from Thebes to El-Amarna, the local artists were employed to decorate both the temples of the Aton and the palaces, houses, and tomb-chapels, of himself and his courtiers. If this suggestion is correct, then what we have always been taught to regard as a most notable example of realism in the art of El-Amarna, namely, the odd-looking figures of the king and his entourage, is, far from being realism, a gross affectation, inherited by the late Eighteenth Dynasty craftsmen of Cusæ from their Middle Kingdom predecessors and further developed and exaggerated during the intervening period.

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Our Neighbour Worlds

By the Rev. Hector Macpherson, M.A., F.R.A.S., F.R.S.E.

I. THE DWARF PLANETS

The Solar System, over which the vast mass of the Sun exercises dominating authority, is composed of bodies of two types—firstly, the planets, which are solid globes of varying volume, mass, and density, which may be called more or less permanent and completed worlds, and which are themselves, with two exceptions, centres of subordinate systems of moons or satellites; and, secondly, the surplus matter which has been left over in the process of planetary evolution, and which exists in the form of comets, meteors, and asteroids. It is true that it has been customary to group the asteroids with the planets, for they have many planetary characteristics, but the discovery in recent years of innumerable small asteroids, some of them only a few miles in diameter, has shown that there is no hard-and-fast dividing line between these bodies and isolated meteors and the clusters of meteors which we call comets.[1] It would seem then that, so far as we know at present, there are only eight bodies in the Solar System which may be correctly designated as planets.

The planets fall into two main groups—the inner and the outer planets. They may be as accurately designated as dwarf and giant planets. Recent research has familiarised us with the division of the stars into the two groups of giants and dwarfs, and this separation into two types is plainly evident among the planetary bodies composing the Solar System. The giants—Jupiter, Saturn, Uranus, and Neptune—are large diffuse bodies, of great volume and low density, possessing apparently considerable internal heat; while the dwarfs—the Earth, Venus, Mars, and Mercury—are comparatively small worlds, of considerable density, and with cool, solid surfaces.

Planetary astronomy—the study of the surface-features and physical characteristics of the planets and their satellites—has not been characterised by the startling progress which has marked the development of stellar astronomy in recent years. In the study of the planets, the telescope, unaided by spectroscope or camera, still holds the chief place. In the investigation of the atmospheric envelope of the giant planets, it is true, photography is of some service and the spectroscope is a useful adjunct, but even here visual observation is of the greatest value. And in the case of the dwarfs, where the main object of the observer is the detection and delineation of minute surface detail, the spectroscope and camera play a very subsidiary part.

Mars

Of the three dwarf planets, which along with our own Earth form the group, Mars has been the most persistently studied, and as a result we are more familiar with its surface than with that of any other body in the universe, except the Moon.[2] For we on the Earth are in a peculiarly favourable position for the observation of Mars; when the planet approaches the Earth most closely, it is in opposition [3] to the Sun and its disc is

[1] The affinity of asteroids to comets was pointed out by Sir William Herschel as long ago as 1802.

[2] In a sense, indeed, we know Mars better than the Moon, as one lunar hemisphere is permanently concealed from our view (since the Moon always keeps the same face turned towards the Earth).

[3] A planet is in "opposition" when it rises at sunset, culminates at midnight, and sets at sunrise.

fully illuminated, and thus observation of its surface can be prosecuted for weeks and even months at a stretch. At favourable oppositions Mars is only 34 to 40 million miles away—which is, cosmically speaking, a trifling distance—yet the Martian disc never appears so large as that of Jupiter. It is much nearer to us, but its diameter is only about 4,200 miles—a little more than half that of our own world. And in small telescopes the disc is disappointingly small. Thus the progress of Martian astronomy was at first slow.

Before 1777, two facts alone had been ascertained. In 1638 Fontana, of Naples, caught glimpses of dusky markings on the little red disc, and his observations were abundantly confirmed by Huyghens in 1659, while in turn the Dutch astronomer's surmise that the Martian day was not dissimilar to our own in length was verified in 1666 by the elder Cassini, whose determination of the period as 24 hours 40 minutes was a remarkable approximation to the truth at that early stage of telescopic astronomy. In 1719, Maraldi, the nephew of Cassini, detected at the poles of the planet the two brilliant white spots which have since been known as the polar caps. The systematic study of Mars may be said to date from Herschel's significant discovery of the variation in size of these polar spots in accordance with the seasons. "I may well be permitted to surmise," Herschel wrote in 1784, "that the bright polar spots are owing to the vivid reflection of light from frozen regions; and that the reduction of these spots is to be ascribed to their being exposed to the Sun."

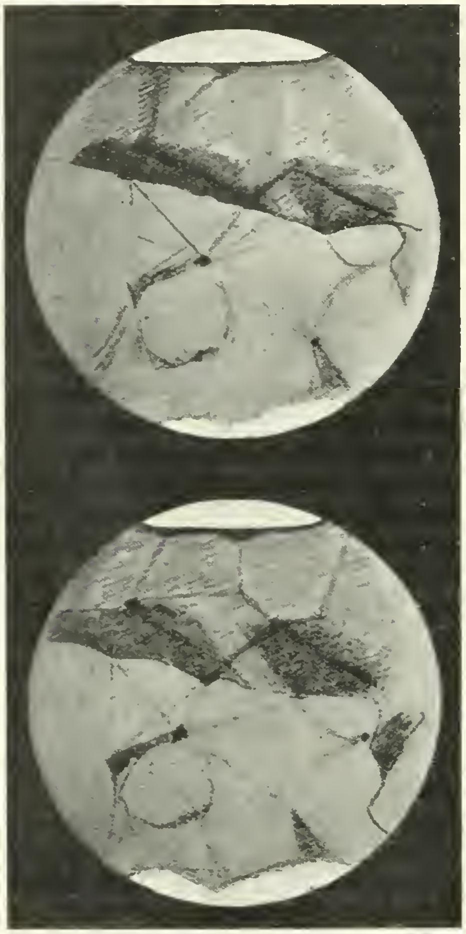
Herschel's study of Mars was only a part of his wider investigation of the structure of the Universe; and accordingly he made no systematic series of drawings, nor did he attempt to chart the planet. This was reserved for the famous German astronomer Mädler and his wealthy pupil Beer, whose survey of the planet occupied them for nine years, from 1830 to 1839. The telescope employed by Beer and Mädler was a comparatively small one—only four inches in aperture—and only the larger surface-markings were charted by them. But their work was continued during the middle decades of the nineteenth century by a number of observers of great skill and patience, chief among whom was the English astronomer Dawes, from whose drawings Proctor constructed in 1870 the first detailed map of Mars.

The conception of our neighbour world which was then current was summarised in Proctor's phrase—"Mars, the miniature of our Earth." It was assumed not only that the polar caps were masses of snow and ice, but that the reddish-ochre portions comprising the greater part of the planet's surface represented the continents, while the blue-green areas were the oceans. It had long been known that Mars had an atmosphere, and clouds and mists had occasionally been observed. Points of difference between our Earth and Mars had, of course, been noted—for instance, the much smaller area of the Martian disc occupied by seas—but on the whole the work of the earlier nineteenth-century observers seemed to confirm Herschel's opinion that "the analogy between Mars and the Earth is perhaps by far the greatest in the whole Solar System."

A new era in the study of the planet was opened in 1877 when Schiaparelli, the greatest Italian observer of last century, commenced at Milan his long-continued series of observations. Something of a sensation was caused by his announcement that the continental areas were intersected by a number of straight dark lines, to which he gave the name of *canali*. It subsequently transpired that Dawes and Secchi had actually seen and drawn some of these markings, but had simply classified them as straits. To Schiaparelli, therefore, belongs the honour of first recognising their true nature. At each subsequent opposition, Schiaparelli detected new canals, and in 1879 and again in 1881 he observed that a number of them appeared to be double; but it was not till 1886 that Schiaparelli's discovery was confirmed by Perrotin and Thollon, of the Nice Observatory. Within the next decade, however, many observers, both in Europe and America, succeeded in seeing and drawing these strange markings; and as the canaliform appearance was gradually established as a true characteristic of the Martian disc, numerous theories were advanced in explanation of it. Most of these, such as the hypotheses that the canals represented mountain chains or huge fissures of enormous breadth and width, have only a certain historical interest. More plausible was the view originally advanced by Cerulli, of Teramo, developed by Newcomb and championed by Maunder, that the phenomenon of the canals "grows out of the spontaneous action of the eye in shaping slight and irregular combinations of light and shade, too minute to be separately made out, into regular forms." This theory had a certain vogue for a considerable time, but it may be said to have been discredited by the observations of the past thirty years, and more especially by the success of the observers at the Lowell Observatory, in 1905 and at subsequent oppositions, in photographing the more prominent canals.

Recognising the importance of clear and steady air for study and interpretation of the Martian markings, two of the ablest American astronomers inaugurated, early in the last decade of the nineteenth century, astronomical observatories of a novel type. In 1892 Professor W. H. Pickering commenced observations on Mars from the Harvard College station at Arequipa, on the slope of the Andes, in Peru, and this work he still carries on at the Harvard branch observatory at

Mandeville, Jamaica. In 1894, maintaining that "observatories should be erected where they may see rather than be seen," Professor Percival Lowell, of Boston, founded and equipped the Lowell Observatory at Flagstaff, in Arizona. Here for the period of twenty-two years, until his premature and lamented death in 1916, Lowell untiringly scrutinised the surface of Mars, following the planet for long periods both before and after opposition. The work of Lowell, Pickering, and the various observers who have assisted



MARS 1907, July 8–12. (LOWELL OBSERVATORY.)

and collaborated with them has in great measure revolutionised our knowledge of Mars.

The observations of Schiaparelli himself had cast doubt upon the aqueous character of the so-called "seas"; and W. H. Pickering's observations in 1892 still further weakened the conventional theory. In 1894 Lowell and his assistant, Douglass, announced that the canal-system was not confined to the reddish-ochre or continental areas, but was planet-wide, the canals traversing the so-called oceans as well as the continents. It became obvious, therefore, that there are no permanent bodies of water on the Martian surface, the so-called seas are simply low-lying tracts of vegetation, and that the only "seas" on our neighbour world are temporary—the polar seas which result from the melting of the ice-caps in the spring and summer, and the temporary floods which overspread low-lying areas from time to time.

Of special significance was Pickering's detection, in 1892, of round spots at the junctions of the canals, the existence of which Schiaparelli had suspected, but had never been able to place beyond doubt. These were called "lakes" by their discoverer, in keeping with the older views of the planet's physical condition. This discovery was confirmed by Lowell, who detected considerable numbers of these spots; he designated them as "oases," in keeping with the newer view. For Lowell demonstrated beyond doubt that the continental areas are desert lands—"not only land, but nothing but land—land very pure and simple; that is, deserts." The dark lines designated as canals and the dark spots at their junctions were shown to be vegetal in their nature, as Schiaparelli suggested soon after their discovery. For the canal-system is obviously dependent upon the polar cap. As the cap melts the canals darken, and a wave of verdure sweeps from pole to equator and into the opposite hemisphere. Obviously the melting of the snow-fields, on a world where water is scarce and where the air is clear and dry, is the controlling factor in the planet's physical life. In some manner the narrow strips of vegetation which we call canals are fertilised by water from the polar seas, which are formed from the melting snows.

Here certainty ends, and we must be content with hypotheses more or less plausible. The most thorough-going and elaborate theory is that which Lowell enunciated in his first book on *Mars* in 1895, and developed in his later volumes—a theory which is familiar even to the casual reader of scientific literature. In his view, the canal-system can only have come into existence as the result of intelligent agency. Mars is relatively a much older world than ours, in the later stages of planetary existence. Water is scarce, and if there are inhabitants there, they must be fighting a grim battle against the spectre of death by thirst. The geometrical regularity of the canal-system, and the rate of development of the individual canals—indicating a transference of water "in the face of gravity"—were held by Lowell to point to the existence of intelligent life on the planet, at least within the areas which he termed "oases," and which he believed to be centres of population or "city-states."

Various alternative theories have been put forward, and from time to time Professor Pickering has outlined possible explanations of the canals. In 1915 he suggested that the water necessary for the growth of vegetation in the strips known as canals might be

artificially drawn from the atmospheric circulation of the planet, or, alternately, that fogs might be artificially localised by electrical means—a theory which would obviate the necessity of believing in a world-wide system of irrigation. In 1918 he put forward another hypothesis, in which he seeks to explain the canals without having recourse to the theory of intelligence. According to this "aerial deposition theory," "the water from the melting polar cap is deposited on the three main depressions on its border, and is then evaporated and carried by the aerial circulation of the planet along the curved lines which in accordance with Ferrel's theory of the winds it must necessarily follow. The storm clouds, which in that rare atmosphere should condense at night, would in this manner carry the water and deposit it in the elongated marshes which we see and call canals." This hypothesis, however, can hardly be called wholly satisfactory, and it must be admitted that Lowell's theory—startling though it is in its implications—would seem to be more capable of explaining the observed facts than the alternative hypotheses.

Recent astronomical research has emphasised the difference rather than the analogies between Mars and the Earth. Thus we know that the surface of Mars is comparatively flat—that there are no mountains worthy of the name on our neighbouring world ; nor are there any large bodies of water on the Martian surface ; if ever there were permanent oceans they have long since disappeared. The planet's atmosphere, too, is very rare—" thinner at least by half," according to Lowell, " than the air upon the summit of the Himalayas " ; and its surface-pressure, Pickering believes, is likely to lie between one-half and one-tenth of that at the Earth's surface. The Martian atmosphere is much clearer than ours. It is not, however, absolutely cloudless. " Clouds," Pickering wrote in 1914, " are nearly always visible on the disc, but they are not usually reported because they are difficult to observe. . . . In the polar regions the clouds are sometimes so white as to be with difficulty distinguished from the snow. After they have disappeared at the poles, the ground is often seen to be white with freshly-fallen snow. Sometimes cloud-masses partially conceal a whole hemisphere, and cloudy nights appear to be frequent." During the opposition of 1920, the observers at the Lowell Observatory were impressed by the unusual haziness and cloudiness of the Martian atmosphere. But we may say that Mars is usually a world of blue skies and bright sunshine.

Despite the greater distance of Mars from the Sun, the difference in temperature does not appear to be so great as might be expected. It has been calculated that the theoretical mean temperature is nearly 0° F.—considerably below the freezing-point of water. But this estimate is totally at variance with the observed facts, and the presence of vegetation, and the obvious existence of water in a liquid state, indicate a much higher temperature. For of the existence of water there can be no doubt, the lines of water vapour having been identified in the Martian spectrum by Huggins and Vogel, and conclusively by V. M. Slipher at the Lowell Observatory in 1908. In his last book, Lowell, from a theoretical conclusion based not only on distance but on the transparency of the Martian atmosphere, found the mean temperature of the planet to be about 48° F., which agrees with observation.

Mars differs from the Earth in the absence of any satellite of appreciable size. Until about half a century ago, indeed, it was believed that Mars possessed no moons, and the discovery by Asaph Hall at Washington during the memorable 1877 opposition, of two tiny satellites, was quite unexpected. These two moons are very small, appearing as stars of about the tenth and twelfth magnitude. Phobos, the larger and nearer of the two, would appear to have a diameter of about thirty-six miles, and Deimos, the more distant, of about ten miles. Obviously, these little satellites belong to an order of bodies altogether inferior to our Moon, and it is not impossible that they may be asteroids which have come in the course of ages within the sphere of influence of Mars and thus been captured.

Venus

Venus is our nearest planetary neighbour, and has been defined as the Earth's sister world. Nevertheless, our actual knowledge of our nearest neighbour is very scanty. When nearest to us, Venus is directly between the Earth and the Sun and is invisible ; and in addition we never see the planet as a fully illuminated disc. The thick atmospheric envelope, too, with which Venus is surrounded renders the discovery of surface detail a matter of great difficulty. For over three centuries astronomers have scrutinised its surface, yet to-day even the length of its rotation period is a matter of uncertainty. Cassini, in 1666, concluded that his observations pointed to a rotation period of about 23 hours ; and this estimate was confirmed by the German astronomer Schröter in 1789 and again in 1811, and in 1844 by Di Vico, of Rome, who fixed the length of the planet's day as 23 hours 21 minutes 22 seconds. These results, however, did not inspire much confidence. For Herschel, by far the greatest planetary observer of his day, was quite unable to see the spots which Schröter had used to determine the rotation period. The diurnal motion, he said, " on account of the density of the atmosphere of this planet, has still eluded my constant attention, so far as concerns its period and direction."

In 1877 Schiaparelli turned his attention to the

problem, and for a period of thirteen years he kept the planet under observation, following it for long periods in the daytime. His conclusion was a startling one—that, so far from the period being of 23 or 24 hours, it synchronised with the period of revolution—225 days. This result indicated that Venus turned one face constantly toward the Sun, and that in one hemisphere there is perpetual day and in the other everlasting night. This conclusion was confirmed in 1895 by a second series of observations by Schiaparelli himself; and by Perrotin at Nice, Tacchini at Rome, Cerulli at Teramo, and in addition by Lowell at Flagstaff, Arizona. Nevertheless other competent observers, including Flammarion, were satisfied that the rotation was performed in a period of about 24 hours.

About twenty years ago, the spectroscope was applied to the solution of the problem. By means of Doppler's principle, Bélopolsky, the Russian astronomer, arrived first at a period of 12 hours and later of 24 hours, while Lowell and his assistants at Flagstaff found that "the evidence of the spectroscope is against rotation of short duration, and so far as its measure of precision admits, the investigation confirms a rotation of 225 days."

Last summer, Professor W. H. Pickering announced the results of his observations on Venus during the favourable appearance of the planet in the previous winter. In December 1920 Pickering detected two dark spots near the terminator, and by following these spots — their appearances and disappearances — he reached the conclusion that the planet rotates in a period of 68 hours, and that the axis of rotation lies very nearly in the plane of the planet's orbit. So far this is the last word on the subject. If Pickering's rotation period prove to be accurate, it may be possible to reconcile the discordant results reached by distinguished observers.

That dark markings and dusky shadings appear from time to time on the dazzling disc of Venus admits of no doubt. It is, however, difficult to speak with any confidence as to their nature. They may represent irregularities in the surface, as has been generally maintained; or, as Pickering suggests, they may be due to breaks in the cloud-laden atmosphere. White spots have been suspected from time to time, and occasionally brilliant markings have been seen, and interpreted as polar caps or as the snow-clad summits of high mountains; but there is no certainty concerning the reality of these appearances.

Mercury

If little is known of Venus, still less is known of Mercury, the smallest of the four dwarf planets. Mercury is situated much closer to the Sun than Venus; it is a small world—only 3,000 miles in diameter—and it is comparatively at a great distance from us. The first systematic series of observations was made by Schröter at the beginning of the last century. This patient though not brilliant observer discovered that the southern horn of the Mercurial crescent presented a blunted appearance—a fact which he attributed to the existence of a high mountain or mountains. He also reached the view that the planet's rotation was performed in a period of about 24 hours. This estimate was not received with any degree of confidence; yet Schiaparelli's announcement in 1889, at the close of his seven years' study of Mercury, that the period of rotation equalled that of revolution, was received with a certain degree of scepticism. His conclusion, however, was abundantly confirmed by Lowell at Flagstaff, and it is now generally conceded that Mercury turns always the same face to the Sun just as the Moon does to the Earth. This conclusion, in the case of Mercury, is theoretically confirmed by Sir George Darwin's hypothesis of tidal friction.

Mercury, in fact, seems to resemble the Moon more than any other celestial body. The balance of evidence would seem to favour the view that the little planet has no appreciable atmosphere, and that its surface is rugged and mountainous. According to Lowell, whose observations were prolonged and exhaustive, the dark markings which revealed themselves to his search merely represent huge cracks in a barren and lifeless world; "the surface of Mercury," he concluded, "is colourless—a geography in black-and-white." Mercury, then, would seem to be a slightly larger edition of the Moon—a world in the last stages of planetary decrepitude.

(To be continued)

The Courtship of the Red-throated Diver

By Julian S. Huxley, M.A.

Fellow of New College, Oxford

Bird photography is a splendid sport. In so far as it is a sport, it is an end in itself. Looked at objectively, it has the further great advantage that it does not destroy but helps to preserve; those who have watched a bird for days together from a hiding-tent will never wish to kill the creature whose inmost life has been displayed before their eyes. Further, like any sport, it brings with it knowledge of its objects. But while the bird photographer cannot help acquiring much intimate knowledge of the birds he photographs, the acquisition of knowledge is not his main aim, and too often his opportunities for enlarging science are wasted.

I have elsewhere [1] drawn attention to our extraordinary ignorance regarding the habits of many even of our common birds. Isolated facts are something, but systematic observation and thought, systematic about what one observes, are needed to lighten the darkness.

The observations here recorded were made in Spitsbergen on the Oxford University Expedition in July of last year. The photographs accompanying the article are incidental only, for, alas! it was impossible to secure photographs of any of the courtship activities, as these take place on open water away from the nest. I have therefore had to supplement them with thumbnail sketches, which I think are better than no illustration at all.

The Red-throated Diver presents a particular instance of a problem which has long exercised me. In the Divers, as in the Grebes, the Herons, the Cranes, and many other birds, both sexes are alike, and both brightly coloured; and, as we shall see later, the bright colours are used in courtship. When one sex only has special ornaments, be they of colour, structure, scent, or voice, we can fall back upon some modification of Darwin's famous theory of sexual selection. In such case, the ornaments of one sex are an assistance to successful mating; for the members of the other sex exercise some sort of discrimination, and are not equally pleased or stimulated by all cock birds. Thus there is a growth of ornament in one sex which is determined in the long run by the "taste," if we may use the word in a somewhat metaphorical sense, of the other sex. The theory has had to be modified in various minor respects, but its main principle holds firm: that the female needs stimulating, that stimulation is provided by the beautiful and by the strange in the male, and that therefore the mind of the female exerts a selective influence in evolution over these special male characters.

What, however, are we to make of the facts when both sexes have bright colours, or special structures, like the Grebe's ruff or the Egret's plumes, which all analogy would lead us to suppose were used in courtship?

The puzzle is still far from being completely solved. But my previous observations on the Crested Grebe and various Herons and Egrets, like those of Edmund Selons on Grebes, Guillemots, Fulmars, and other birds, have at least led to two perfectly straightforward results. In such cases the bright colours and special structures *are* used in courtship (using that word in an extended sense to cover all ceremonies based upon the sexual emotion); and they are almost always used by both sexes in equal degrees. The habits of the Diver corroborate these results.

The terrain of my observations was the eastern edge of Prince Charles Foreland, a sixty-mile island off the west coast of Spitsbergen. Between the central mountain backbone and the sea there extended a comparatively flat strip of land, a mile or so in width, with small scattered lochs—the nesting-places of the Divers. Close to our camp there was also a large brackish-water lagoon, about five miles in length, separated from the sea only by a narrow spit of shingle; here the birds often came to rest and to fish.

[1] *Proc. Zool. Society*, 1914; *The Auk*, 1915.

In this latitude the Divers have a very short season in which to bring off their young. When we arrived, on June 30, the little lochs were all quite, or almost quite, frozen over, and nesting was out of the question; and September brings the rapid autumn. It is therefore imperative for the birds to start nesting as soon as they can; that they do so is shown by the fact that I found a nest with one egg only seven days after the first sign of thaw in one loch, another nest with the complete complement of two eggs eight days after the beginning of the thaw in another loch. The first nest was within three or four yards of a snow-bank.

THE RED-THROATED DIVER ON ITS NEST.

In passing, some of the curious methods of progression of the bird may be noted. The nest is always somewhat raised to protect the eggs from possible floods, and is often at some yards' distance from the water. When the water is very shallow, the Divers progress by their well-known but none the less extraordinary method of resting their breast on the ground, and then giving a great kick with their legs so as to propel the whole body upwards and forwards, the breast coming down again with a bump. In this action, the hind-quarters are disproportionately raised and the motion is like that of a very clumsy rabbit slowly moving forward. When there is a stretch of dry land to cover, the bird may walk erect; but it can only advance a few yards at a time in this way, dropping down to rest for a little before trying the erect posture once more. I say "erect posture," but it is a travesty of the erect posture that the bird adopts. The legs are placed so far back that the body leans a

little forward ; and the neck, presumably so as not to throw the centre of gravity further up, is bent down in an ugly curve half-way to the ground. The bird only saves itself from falling forwards by moving, and can only do so, as I said, for a short time.

On reaching the nest, she almost always, while still standing, carefully presses the two eggs well into her feathers with her beak, then sitting down and rolling from side to side to get them comfortable. After a few minutes she will usually rise and rearrange the eggs.

I was watching the nest with one egg, referred to above, with a telescope, from a hiding-tent some forty yards away. The hen had been sitting steadily for several hours, protecting the egg from marauding skuas and gulls. Suddenly her mate flew down onto the pool. Almost at once she left the nest, made towards the cock, and swam round him several times with her neck extended in front of her—a snake-like pose, but one rigid with excitement. However, he was unresponsive. Soon after, she gave what I call the "splash-dive." The bird dives with a flick, sending a shower of spray into the air (as opposed to the noiseless submergence of serious diving for food), to emerge only a few feet away, always close to its mate. This was repeated four or five times, and stimulated the cock to a little similar diving. I have since found that this splash-diving is always associated with excitement (sometimes with quite other forms of excitement, as when one very tame bird employed it in anger when I drove her off her nearly-hatching eggs), and seems to be especially used as a stimulus by one bird of the pair—it may be either male or female—to key up the emotions of the other. Immediately afterwards they swam together to a low bank of green moss, onto which the cock scrambled. He stood upright, stamped alternately with his feet, and sank down to rest. I found later that he was sitting on a rudimentary nest, a "cock's nest," such as also is built by the Crested Grebes ; and found a similar cock's nest on the other nesting-pool that I was able to investigate thoroughly.

A REMARKABLY FEARLESS DIVER SNAPPING AT AN INTRUDER (THE WRITER).

The cock picked at the moss, and seemed to be building pieces of it into the "nest." The hen meanwhile, although the water was scarcely deeper than herself, was giving splash-dives over and over again. On a subsequent visit to the same place she occupied herself in ducking under, pulling up great pieces of moss from the bottom, throwing them aimlessly over her shoulder, and repeating the process.

From what I afterwards saw, it became clear that each pair had a special place, like this moss-bank, where there was a cock's nest and where the act of pairing always took place—a nuptial bower.

Two points deserve special notice. First that in other species where such special pairing-places are found, they usually contain a rudimentary nest ; for instance, in the Crested Grebe. This bears out Selous' contention that the whole sexual life of the birds originally centred round the nest, and that now we see a "division of labour" between the two functions of the nest—the incubatory in the true nest, the nuptial in the rudimentary nest by the pairing-place.

Secondly, and in a way arising out of the first, we have the strong association between nest-material and the emotion of love. This association is by no means confined to species which have special pairing-places. To choose but three examples, not only does the grebe have elaborate ceremonies in which bunches of weed dived for from the lake-bottom play a prominent part, but herons and egrets present each other with twigs to an excited ceremonial accompaniment, and the mates of warblers often make their displays before the hens with a leaf or twig held in their beak. Mental association, in fact—and this is an important general conclusion—plays a large part in building up the complicated courtships of birds, and so presumably in their whole mental life.

The mate of this particular pair of mine shortly flew off, but returned again later in the day. This time, the typical ceremony of the Diver's married life was gone through. After some preliminary diving, the two birds both put themselves into the characteristic position. The neck was arched right forward, the head bent down ; the beak was open, and its lower third or half was submerged in the water. From both birds issued an extraordinary cry, which in my notes

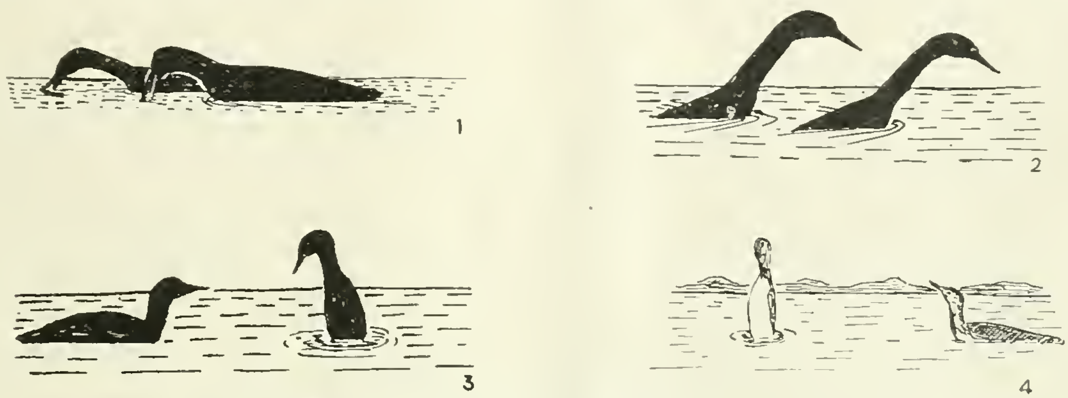
is described as "a growl with a bubble in it," and a "rolling groan"; perhaps I may leave it at that! In this position they swam rapidly across the pool, the male leading, uttering the cry again and again; they then turned, and repeated the process, but with the female now leading; then stopped, and resumed the ordinary business of life. We may call this form of courtship the "beak-dipping ceremony."

This was the commonest ceremonial of the birds. I saw it both on the little lochs and on the big lagoon, and the strange guttural cry that was its sure accompaniment came often to our ears, at all hours of day and night.

As far as ceremonies later than the time of pairing up are concerned, the Diver is very similar to the Crested Grebe, but with much less variety of courtship action. The main point of resemblance is that both male and female birds play either interchangeable or identical rôles; there is no courting of one sex by the other exclusively, as in peafowl or black game or warblers.

I was particularly lucky, however, in seeing a good deal of the earlier stages of courtship, those which lead to the selection of mates for the season. These are notoriously difficult to observe in most birds; here it was largely our good fortune in being close to the lagoon which helped me to this result. The lagoon served as a common rendezvous for all the Divers in the neighbourhood. Sometimes they would fly out to sea to fish, or across to the other side of the island; but a great deal of their fishing, and, above all, of their resting and their courting, was done on the lagoon's tranquil waters. I have seen as many as ten scattered birds on it at once, and little flocks, real social gatherings of five or six, were not uncommon.

During our first four days, the lochs were all frozen over, and nesting was impossible; it was then that the selection of mates was going on most rapidly. As is usual with bird-watching, we at first found the creatures' antics quite unintelligible. Among a group on the lagoon, there would suddenly be a commotion; birds would be seen—usually a trio, but sometimes two and sometimes four—ploughing the water in an extraordinary attitude. Their bodies would be submerged (this power of voluntary submersion of the body being common to all Grebes and Divers), but tilted up in such a way that just the breast and shoulders were above water. The neck was stretched stiffly up and forwards, about 30° in front of the vertical; and the head inclined slightly downwards. In this attitude they had a very remarkable appearance, like miniature Plesiosauri restored to life. Again, as often in birds' ceremonials, there was a tense, rigid look about their attitude. Resistance to movement must have been considerable, as a wave was thrown off from their advancing breasts. In this attitude they would progress for a considerable distance, less as if one of them were being pursued than as if all were running some form of race. (In fact we christened the ceremony "the race of the Plesiosauri.") Then they might turn about, and come back with a different member leading.



(1) THE BEAK-DIPPING CEREMONY. (2) THE PLESIOSAUR RACE. (3) and (4) VERTICAL EMERGENCE FROM DIVING.

At other times they would give the same performance but raised to greater heights of excitement, the wings spread and drooped and beating the surface of the water.

Then we repeatedly saw the extraordinary spectacle of one bird diving to emerge close to another in a nearly vertical position. The whole white undersurface would be exposed to view, the bird seeming almost to stand on its tail in the water, and then slowly settling down to a sitting position. This vertical emergence, too, is paralleled in the behaviour of the Crested Grebe.

When it is remembered that the performance characterising mated pairs was also to be seen on the lagoon, that "splash-diving" was frequent, that fighting and jealousy often gave rise to much confused action, and

finally that all this had to be observed through a telescope, it will be understood that my first feeling was one of bewilderment.

Gradually, however, order began to come out of chaos. The "Plesiosaur" attitude and the racing, it was found, are used only in the period before mating up; that is why three (or even four) birds usually participated in them—it is in a sense a competition for a mate. Unfortunately the two sexes are difficult to distinguish. The female is smaller and more delicately built—that is all. Sometimes identification is certain, sometimes almost impossible. However, I can at least say that it is highly probable that such trios might consist of two cocks competing for one hen, or two hens competing for one cock. In any event there is no doubt that they are competitive in the sense that they play a part in the selection of mates; and no doubt that there is no display of one sex before the other, but ceremonial and emotional actions identical in the two sexes. The Diver is, so far as I know, the first species in which this has been shown to be so, although I have no doubt that in many birds with both sexes similar the same will prove true.

The diving and emergence in vertical position is also, so far as I could judge, only used in this first, unmated, period. It seems to be employed more as a definite means of excitation, a display, but again, almost certainly, by either sex. At any rate, in the only two cases, where I could be sure of the sex, the performer was a female.

A curious psychological fact remains to be mentioned. It was first noticed by Mr. Elton, another member of our party, that the birds on the lagoon would often immerse part or all of their beaks and sometimes their whole head, as if looking for fish. Later we became puzzled as to why this action so often seemed to be a prelude to courtship ceremonies; and finally I became convinced that it was, through some obscure mechanism of the brain, definitely associated with them. I had previously found that in the Crested Grebe both the shaking of the head and the strange aimless attempt at preening the wing-tips and tail were similarly associated with courtship actions. We can only suppose that actions, originally neutral, have been seized upon by the forces of sexual selection and used as the raw material of the strange ceremonies of sex. In the Grebe it is quite certain that the commonest form of nuptial courtship action, in which the ruff is spread and the head violently swung from side to side, is simply a specialisation and ritualisation, as one may call it, of the ordinary shaking of the head seen when water-birds preen themselves. It is possible that the curious habit of the Divers in holding their beaks half-immersed during the mutual "beak-dipping ceremony" that I have described, has its origin in the holding of the head under water when looking for fish. In any case, we have here one further example of the strange ways in which mental association works in birds.

I had almost forgotten to mention that the voice plays an important part in the post-nuptial courtship. Those who know the Red-throated Diver will remember the extraordinary wildness and sense of pain in the bird's mewing, cat-like howl. That we are really reading much of this emotional tone into the cry is shown by the fact that it is used in courtship. Very often as a preliminary to the beak-dipping ceremony there will be a duet of these wild cries; and eventually, whenever I heard such a duet—and it was easy to hear, since it carried for miles through the Arctic solitude—I got my glass ready to look at the rite which I knew would follow. Here again we have a ceremony shared mutually by both birds of a pair, but appealing to the ear instead of wholly or mainly to the eye; and this again is paralleled by the love-duets of the Dabchick and of some species of Owls.

In these various ceremonies the bright colouring of the birds is shown to the best advantage. In the "Plesiosaurus Race," the drab body is hidden, the lovely pencillings of the back of the neck visible to the hinder birds; the same is true of the ceremony with submerged beaks. In the splash-dive, on the other hand, the delicate blue-grey of the rest of the neck, with its rich chestnut throat patch, comes into view; this it does also, but now with the additional revelation of the whole of the flashing white belly, in the vertical emergence after diving.

Enough will have been said to show that the Diver's courtship is characterised by strange ceremonies, in which both sexes play an equal part. In conclusion, let me ask anyone who may be in a position to fill any of the gaps in my observations to be so good as to write to me with the information. I shall be most grateful. Especially interesting would be observations on the first period, before mating up, in Great Britain.

The Renascence of the English Short Story—I

By Thomas Moult

The English short story, being the youngest product of literary art, is still regarded with mixed feelings by the average reader of books. *Berenice* was, we are told, practically the first of its kind in English prose, and because it was written by a master like Edgar Allan Poe (1809-49), an audience must have been automatically created for it. That audience does not

appear to have increased to any considerable extent while transferring its attention to Poe's imitators and successors during the eighty-six years that have intervened between *Berenice* and the present ; so that even to-day we have the curious anomaly of a reading public which either regards the form as the especial prerogative of its own favourite writers, or is only willing to look at the work of a writer whose name is unfamiliar if that work is printed in the pages of a popular magazine.

Scarcely anyone buys volumes of short stories unless they are written by Rudyard Kipling, W. W. Jacobs, O. Henry, or Jack London. Only once in its history does the art appear to have reached anything like general prosperity in England. Twenty years ago all the best authors were regular practitioners, the literary periodicals encouraged it, and for the most part it actually rivalled novel-writing in the regard of the reading public, that previously had failed to appreciate it and has been backsliding ever since. It was almost as if readers were taken by the scruff of the neck and compelled to a temporary transfer of their attention. In fact they were victimised by their own favourite authors. A sudden rivalry had sprung up between a dozen first-rate men. Kipling and Conrad contributed some of their best work as short stories, and among others who pursued the art energetically one remembers "Max" and "Q," Zangwill, Jacobs, Morley Roberts, Arnold Bennett, Charles Marriott, the late Stephen Crane, and H. G. Wells.

It is one of this group, indeed, H. G. Wells, who has given the most attractive if not very technical description of the short story. That its period of popularity should have come to an end so swiftly and ingloriously is little short of amazing if we consider how attractive, how surely cut out for popular favour, is the art as there defined. "It is the jolly art of making something very bright and moving," says Wells ; "it may be horrible or pathetic or funny or beautiful or profoundly illuminating, having only this essential, that it should take from fifteen to fifty minutes to read aloud." But Wells has now forsaken the short story for historical tomes, Arnold Bennett for meditations on the frailty of women, and "Q" for Cambridge class-rooms. Only Max Beerbohm, W. W. Jacobs, and Morley Roberts seem to have been faithful to their old pursuit. Perhaps the desertion of the others is due to the fact that, coincidently with the short-story vogue, a second fashion was setting in, a product of an era of scientific discovery, whose significance was about that time beginning to impress the general mind. To despise the literature of plot and incident, seeing value only in the analysis of psychological processes, was a habit that formed itself without opposition among the more thoughtful type of authors.

In the light of later events we can see that this was the beginning of the end of the short story in its then (1890–1905) legitimate sense of the word. Not that to attempt a technical definition as distinct from H. G. Wells's generalisation is an easy matter. We are in danger of limiting the term so closely as to exclude narratives which may properly be regarded as falling into this class of fiction : or we may make the definition too inclusive. There are, as a matter of truth, so many kinds of short story that it would be less difficult to say what the short story is not. For example, it is neither a novel, condensed novel, nor novelette. Its plot is hardly ever complex, it is not a sketch (which is a still life affair, while the short story requires movement), nor an anecdote—and this rules out a good deal of O. Henry's work, and also such vague generalities as that of the editor of an American magazine which prides itself on its "short stories." The business of the writer is, says this editor, "to make a real impression without taking pages to accomplish it in, to reach the human heart in a human way, inspiring in the reader, by the use of not more than two or three thousand words, a genuine emotion of love, awe, and pity." All of which demands even the anecdote may easily meet.

Before proceeding further we had best here lay down that the short story is a single-themed narrative, artistically presenting characters in a struggle or complication which has a definite outcome. If the action occurs in a brief time and in a closely circumscribed space, the story approaches the ultimate or ideal type. *Swept and Garnished*, by Rudyard Kipling, *The Idiot*, by Arnold Bennett, and *The Three Strangers*, by Thomas Hardy, each in their separate ways, by closely observing the limitations of time and place, consciously or unconsciously obey the laws of the Unities of Place, Time, and Action laid down for the Drama by Greek critics. Contrariwise, *The Jumping Frog*, by Mark Twain, and Jack London's *Love of Life*, prove the elasticity of the form as regards these Unities.

But in each of these stories, whether they be elastic or rigid, we have the concentrated imaginative form, whose justification for existence once seemed to be the tale it contained. Three of them are written by men who either had a share in that prosperous period of twenty years back, or were the direct product or survival of it. With the decline of prosperity for the short story, literary style became of exaggerated importance, and the subject insignificant. The new writer recorded a "phase," an "episode." There was no longer any vital necessity, aspirants were told, for more than a single character ; and, being a physical figure, even this one character hardly counted, nor did it matter if the action, all told, amounted to no more than the lifting of an eyebrow !

For purposes of comparison, let us take an example from each period—that which may roughly be defined as the period of "plot," in which the story told was of primary importance; and that of "phase" or "episode," in which the method of the story-teller mattered to a degree which would make the authors a fit study for the psycho-analyst. In *Mary Postgate*, by Rudyard Kipling, there is an episode of bomb-dropping. After the explosion, Mary and Nurse Eden heard "a child's shriek, dying into a wail":

"Nurse Eden snatched up a sheet drying before the fire, ran out, lifted something from the ground, and flung the sheet round it. The sheet turned scarlet, and half her uniform too, as she bore the load into the kitchen. It was little Edna Gerritt, aged nine, whom Mary had known since her baby days.

"'Am I hurted bad?' Edna asked, and died between Nurse Eden's dripping hands. The sheet fell aside, and for an instant, before she could shut her eyes, Mary saw the ripped and shredded body."

Between them, restraint and suggestion are the principal factors in creating the emotional effect here. Which simply means that the writer who cares more for matter than manner generally does well with both, for it is the actual incident described that leads to restraint and suggestion. Against this we may set a passage from Henry James's *The Real Right Thing*, in which the author is speaking of George Withemore, who has been asked to write the life of Ashton Doyne, deceased; nor is the author caring for anything half so much as the actual words he is speaking:

"He was not a little frightened when, even the first night, it came over him that he had really been most affected in the whole matter, by the prospect, the privilege and the luxury of this sensation. He hadn't, he could now reflect, definitely considered the question of the book—as to which there was here even already much to consider; he had simply let his affection and admiration—to say nothing of his gratified pride—meet to the full the temptation Mrs. Doyne had offered him.

"How did he know without more thought, he might begin to ask himself, that the book was on the whole to be desired? What warrant had he ever received from Ashton Doyne himself for so direct and, as it were, so familiar an approach? Great was the art of biography, but there were lives and lives, there are subjects and subjects. He confusedly recalled, so far as that went, old words dropped by Doyne over contemporary compilations, suggestions of how he himself discriminated as to other heroes and other panoramas. He even remembered how his friend would at moments have shown himself as holding that the 'literary career' might—even in the case of a Johnson and a Scott, with a Boswell and a Lockhart to help—best content itself to be represented. The artist was what he did—he was nothing else. . . ."

With this type of short story in the ascendancy (more or less modified, of course, because no writer except James has dared to pursue the method to its logical extreme), it was inevitable that what is a distinct and significant branch of art should have suffered a serious decline. There was still a demand for the short story of plot and incident, and while the older magazines vanished one by one from sheer lack of material, a new and much inferior type of periodical sprang up and took advantage of a public taste which, in the desperation of hunger, had forgotten to discriminate between art and mechanics. The consequence was that a very inferior type of short-story writer sprang up also.

(*To be continued*)

Modern Whaling

By J. Travis Jenkins, D.Sc., Ph.D.

Formerly whales were hunted from rowing-boats by means of a hand-harpoon and lances. The chief species hunted in this fashion were the Right or True whales (*Balænidæ*), and the Cachalot or Sperm whale (*Physeter*). Owing to over "fishing," these species are now so rare that it no longer pays to fit out vessels for their capture. Whaling was consequently rapidly dying out until the invention of a harpoon-gun by a Norwegian sailor, Svend Foyn, in 1864. The capabilities of this gun were not at first realised, and it was not until about 1880 that any considerable development took place. This development was due to the fact that with the harpoon-gun it was possible to kill and capture Finner whales, whose rapid swimming and tendency to sink when dead rendered them immune to the attacks of the old whalers.

The three chief whales, all species of Finners, on which the modern whalers of the North Atlantic depend are the Blue whale (*Balænoptera sibbaldi*), the largest of all living creatures, which sometimes attains a length of 85 feet; the Common Rorqual (*Balænoptera musculus*), and the Sei whale. The first, like the other species of Finners or rorquals, spends the winter in the open sea, approaching the coast at the end of April or the beginning of May. The Common Rorqual grows up to 70 feet in length, and is the commonest of the large whales off the British coasts. It feeds on fish, and is frequently seen among the herring shoals. The Sei whale is a smaller edition of the Common Finner, attaining a length from 40 to 50 feet. Until recently it was considered the rarest of the European whales, but in 1906 no less than 326 specimens of this species were taken by the Norwegian

whalers in Scottish waters, and in normal seasons it forms from 50 to 80 per cent. of the total catch in Faroese waters. These Finners are readily distinguished from the True whales by the presence of a dorsal fin and the plicated skin on the throat.

Normally there are whaling stations at work in the Shetlands, Hebrides, Ireland, Iceland, and the Faroes, but last year, owing to the slump in the value of whale oil, only one station was at work, at Thorsvig in the Faroe Islands. Nearly all modern whaling is in Norwegian hands, and it was a Norwegian firm which had four whaling steamers at work at Thorsvig this year.

The whaling steamer is a small but strongly built vessel from 80 to 90 feet in length. Its characteristic features are the crow's-nest up on the solitary mast and the harpoon-gun in the bows. The harpoon, to which a rope is attached, is shot out from a small cannon fixed right up in the bows of the steamer. The harpoon is tipped with a hollow point called the bomb. This bomb bursts after the harpoon strikes the whale, and often kills the whale instantaneously. Coiled on a pan in the bows is about forty fathoms of a specially strong rope, the Foreganger. From this pan or platform, the rope passes aft to a winch situated in front of the bridge. This winch serves to haul in the whale when it is dead.

Most of the whales are captured at the Faroes within the 100-fathom line, less than a day's steaming

FIG. 1.—THE HARPOON IN WHALER'S BOW, WITH PLATFORM FOR COIL OF ROPE.
The gun is unloaded, and the muzzle points aft.

from the islands. This year, owing to the abundance of the Common Finner, the whalers made no attempt to kill the Sei whale, which in normal years forms the greater proportion of the catch at the Faroes. Up to the middle of July, of a hundred whales taken at Thorsvig, ninety-seven were Finners and three Blue

FIG. 2.—FLENSING A FINNER WHALE (*BALÆNOPTERA MUSCULUS*).
THORSVIG, FAROE ISLANDS.

whales. Occasionally one of the rarer whales is killed, a Nordcaper (*Balæna biscayensis*) being brought in this year on July 22. The modern whaler will shoot at any whale over 40 feet in length.

After the whale is shot it is speedily hauled alongside the steamer, and the tail flukes cut off to facilitate towing to the station. A steel tube is next stuck into the abdomen and air pumped in to keep the whale afloat, the orifice being stuffed with oakum when the tube is withdrawn. The harpoon is left in the carcass until the whale arrives at the platform, where it is flensed, i.e. stripped of its blubber. The dead whales are invariably towed ashore to a whaling station for the extraction of the oil and treatment of the carcass.

After arrival at the station the whale is hauled up a slip on to a flensing platform by means of a powerful steam-winch. A Blue whale may weigh up to seventy tons, and is rightly considered a great catch. First, the valuable blubber is flensed off by a steam-winch, the flenser having made two or three longitudinal incisions down the whale's side to facilitate the removal of the blubber from the underlying flesh. The blubber is then cut up by a machine like a circular saw into small pieces, which are hoisted up into a gigantic boiler. From the blubber the best oil is obtained. The whale " bone " is now removed from the upper jaw and set aside for subsequent treatment. Now comes the turn of the Faroe islanders. The whaling company is compelled by the terms of its lease to sell to the islanders as much whale meat as they require at a fixed price of ten kroner (10*s.*) per small barrel, and the Faroe men crowd round eagerly to get such a

welcome addition to their winter stock of provender. This meat is salted down ; when fresh the meat of the Blue whale is like tender steak, but with a sweetish taste.

After the islanders have helped themselves, the flesh and bones are cut up into manageable sizes and treated in separate boilers, where a second-grade oil is extracted. After all the oil has been extracted, the residue of the bones and flesh is ground up and used for cattle meal and guano. Most of the oil is used for soap-making, but during the war it was sold to the

FIG. 3.—WHALEBONE FROM BLUE AND FINNER WHALE, CUT OUT ENTIRE FROM THE UPPER JAW.

The inner mat-like surface is seen.

manufacturers of explosives for extraction of glycerine. The lower grades are chiefly used for the manufacture of lubricating greases. The average yield of the three commoner species of finner is : Sei whale, ten barrels ; Common Finner, fifteen to seventy barrels ; Blue whale, fifty to seventy barrels.

The whalebone plates are separated, scrubbed, and soaked in warm soda solution, washed in warm water, and dried in the open air. When dry they are packed in sacks. The baleen from fin whales gives fourteen sacks to the ton. Most of the whalebone goes to Paris, where it is used in the form of fine threads woven into silken fabrics for stiffening purposes.

It is extremely difficult to convey an adequate idea of the enormous size of these creatures, but when you see six men exerting all their strength to turn over a relatively small portion of the whale's skull which has been cut off from the rest, you get some idea of their size and weight.

It is doubtful whether whaling will last very long under present conditions. There is general agreement that in the future whaling all over the world should be subjected to regulations for the protection of the few remaining cetacea. All the older " Fisheries "—the Basque fishery of the Bay of Biscay for the Nordcaper (*Balæna biscayensis*), the Greenland or Spitsbergen fishery for the Greenland Right whale (*Balæna mysticetus*), and the great Cachalot fisheries for the Sperm whale (*Physeter macrocephalus*)—came to an end through overfishing. In no case has there been a recovery of the species sufficient for a resumption of fishing, even after an unavoidable close time for over a century.

The great objection to whaling as at present carried on is that so many pregnant females or females with suckling young are killed ; theoretically, there is a prohibition against the killing of the latter in some areas, but there is no means by which a whaler can identify a gravid female while it is swimming in the water.

The whalers themselves say that the Finners will never become extinct, since whaling will automatically stop when it ceases to be profitable. Under normal conditions at present they stop when the whaling steamers get less than thirty whales each per season. The whalers estimate that they kill about one in every ten whales seen, and at first sight that seems reassuring. While it is true that the Common Finner and the Sei whale may be killed off with impunity for years to come, there is strong reason for advocating international protection for the rarer whales, such as the Sperm and the Nordcaper, either by an absolute prohibition of their slaughter for a term of years, or by strictly limiting the number which may be killed at any particular station.

The Teaching of English in England

A Note on the Report of the Departmental Committee appointed by the Board of Education to inquire into the Position of English in the Educational System of England.[1]

MR. FISHER has been singularly fortunate in the various Departmental Committees appointed to inquire into the positions respectively of Classics, History, Natural Science, Modern Languages, and English in the educational system of England. All the reports issued have been of far-reaching importance, but " The Teaching of English in England " is in some respects the most interesting of them all. Certainly it makes a wider appeal than any of the others since the subject concerns not only teachers of every subject in the curriculum of British Universities and schools of every grade, but also every English-speaking man and woman the world over. The Committee were

[1] Published by His Majesty's Stationery Office. Pp. xv + 394. Price 1s. 6d. net.

desired to advise how the study of English "may best be promoted . . . regard being had to (1) the requirements of a liberal education ; (2) the needs of business, the professions, and public services ; and (3) the relation of English to other studies." The reference is sufficiently broad, and they have interpreted it in the broadest possible way, so that the Report as a whole is in itself a tribute to their humane attitude towards learning and a genuine contribution to educational and social science. While it necessarily deals to a large extent with pedagogical matters, it never, even when most detailed in its investigations, becomes purely pedagogic, nor does it ever lose sight of the deeper significance of English studies for English people.

The Introduction at once strikes the right note, when it insists that "the inadequate conception of the teaching of English in this country is not a separate defect which can be separately remedied," but is due to "the failure to conceive the full meaning and possibilities of national education as a whole, and that failure, again, is due to a misunderstanding of the educational values to be found in the different regions of mental activity, and especially to an underestimate of the importance of the English language and literature." It is impossible within the limits of an article to reproduce the sound remarks made in the report on the subject of education in general and the need that it should "bear directly on life, and that no part of the process should be without a purpose intelligible to everyone concerned." But these introductory paragraphs are of immense interest and importance and deserve careful attention.

The Committee next note the fact that in many schools of all kinds and grades the teaching of English is often entrusted to ill-qualified members of the staff and regarded as being inferior in importance. Yet "education in English is, for all Englishmen, a matter of the most vital concern. . . . Until a child has acquired a certain command of the native language, no other educational development is even possible. . . . A lack of language is a lack of the means of communication and of thought itself. . . . If a child is not learning good English he is learning bad English, and probably bad habits of thought. . . . English is plainly no matter of inferior importance, nor even one among the other branches of education, but the one indispensable preliminary and foundation of all the rest." This particular aspect of English language teaching is discussed in various connections. It is, for example, pointed out that inability to put thought into words sets a boundary to thought, and that when a man's vocabulary is limited, he is also incapable of thinking clearly—whatever the subject of his thought. Secondly, "If the teaching of the language were properly and universally provided for, the difference between educated and uneducated speech, which at present causes so much prejudice and difficulty of intercourse on both sides, would gradually disappear." "An education fundamentally English would, we believe, at any rate bridge, if not close, this chasm of separation [between different social classes]. The English people might learn as a whole to regard their own language, first with respect, and then with a genuine feeling of pride and affection." Thirdly, "English" is "the principal method whereby education may achieve its ultimate aim of giving a wide outlook on life."

It is interesting and immensely encouraging in this connection to find in Chapter V ("The Needs of Business") that the forty prominent firms which answered the Committee's inquiries about "the importance they attached as business men to a training in English," agreed that the matter was "one of considerable moment from the standpoint of trade." No less encouraging was their vigorous denunciation of so-called "Commercial English" and "the implicit assumption . . . that British trade would be efficient and successful in proportion to the amount of intellect and imagination brought to bear upon it, and that the schools would best serve 'the needs of business' by developing to the utmost the intellect and imagination of those about to enter the business world."

From the standpoint of trade, therefore, there is no necessity to distinguish between "the requirements of a liberal education" and "the needs of business." Indeed, many of the replies to the questionnaire are explicit on this subject : "Wise guidance in reading we consider the best method to adopt in teaching English" ; or : "Most young people have few ideas because they do not read much" ; or : "We think that a great deal of time . . . would be far better used in the study of English literature in its broader aspects." The Science Masters' Association (to represent which the witnesses examined came from Cheltenham, Eton, and Harrow ; i.e. were speaking from experience of a different type of education) complained similarly that their work was seriously hampered by their pupils' inability to express themselves "in a reasonably adequate manner" either in speech or writing, or to "read English sentences with understanding, or at least with power to say exactly what they did not understand." "They considered that neglect of the mother-tongue led . . . to inhibition of the general power of thinking."

It is not possible here, though it would be well worth while, to summarise the recommendations made by the Committee with a view to the improvement of English teaching to children, adolescents, and adults in every kind of education. Two dicta may, however, be taken as typical of the wise spirit which inspires them all. The first concerns the Universities, and every competent University teacher will endorse what is said : "English, then, is needed in every Faculty. . . . Without it *the student* cannot attain to full powers either of learning or of teaching in any. We should like to see this officially recognised. We should like it to be officially proclaimed by each University that in all its examinations the quality of the English written or spoken by candidates, especially its lucidity and its fitness to the subject, will carry great weight with the examiners. . . . English is . . . an indispensable handmaid without whose assistance neither philosopher, nor chemist, nor classical scholar can do his work properly."

The second is the admirable account of the place of English in the curriculum of technical students, whether in Universities, technical colleges, or evening schools, i.e. whatever the age or intellectual development of the pupils. The Committee are of opinion that for such students

English, "even literature, can and should be given a vocational bias, can be made to bear directly upon the life and work of all those who study it, can, in short, be handled" (as, in fact, it is very rarely handled in British technical education) "as an actuality of vital interest and with an intelligible purpose to everyone concerned." The Report, as an example of what is intended, gives an account of the experiment carried out with engineering students by Professor Frank Aydelotte, of the Massachusetts Institute of Technology (vide pp. 161–4). But similar methods are possible and desirable with students of agriculture, of commerce, or of domestic subjects, and their introduction is of primary importance to education. Anyone who has come in contact with these students either socially or in the class-room will recognise the need for such training in the mother-tongue as will be "a training in thought, the influence of which is to clarify and humanise the student's character and his aims in life."

This humane education cannot be the result of linguistic training alone. The Committee's Report carefully discriminates between the teaching of English language and that of English literature, for, closely interrelated as they necessarily are, there is also a very definite cleavage between them. At its lowest, the use of English is necessary for utilitarian purposes; at its highest, accomplishment in the use of the English language is a fine art, the mastery of which, while all may learn to appreciate it, can be acquired only by the few. English literature also, as the Report is at pains to emphasise, has direct bearing upon life and is of universal importance, but as an art, "as a means of contact with great minds, a channel by which to draw upon their experience with profit and delight, and a bond of sympathy between the members of a human society."

For English-speaking people, English literature may provide a full measure of culture and humane training; it must, in their case, and whatever studies may be added to it, form the essential basis of a liberal education. This is not to belittle any other literature, classical or modern, (and on this point once more we refer the reader to the Report and what is there said on the subject of the classics, p. 18 and elsewhere), or training in any other subject (see p. 14). It is the statement of a fact.

The Report insists on the necessity of treating "literature, not as language merely, not as an ingenious set of symbols, a superficial and superfluous kind of decoration, or a graceful set of traditional gestures, but as the self-expression of great natures, the record and rekindling of spiritual experiences, and in daily life for every one of us the means by which we may, if we will, realise our own impressions and communicate them to our fellows." "The literature of England belongs to all England. . . and all may enjoy it who will."

The Committee do not ignore the fact that "there is another delight besides this open and universal one. In this matter, as in others, the scholar has his own task and his own reward." They discuss in as much detail the curriculum and aims of University "English" as those of every other type of teaching. Here, as elsewhere, they raise many controversial questions, and individual readers will have their own opinions about the solutions offered or the suggestions made. Already the discussion about English grammar has produced criticism from various quarters; much will no doubt be heard on the subject of University Schools of English, and so with regard to almost every important question as it affects the curriculum or methods at the various stages of instruction. But such discussion is in itself stimulating, and the Report would have served a useful purpose had its publication caused merely an awakening or renewal of interest in themes, a tithe of which we have perforce left untouched.

In this short note it has been possible to call attention only to the broader aspects of the Report and to the spirit by which it is animated. The writer is convinced that if it be widely read and its teachings taken to heart, it contains enough matter to produce a revolution not merely in the "teaching of English," but also in the national conception of what is implied by a liberal education.

EDITH J. MORLEY.

Reviews of Books

SOME BOOKS ON CHEMISTRY

(*a*) *Early Science in Oxford.* Part I—Chemistry. By R. T. GUNTHER, M.A. (H. Milford, 10*s.* 6*d.*)

(*b*) *An Introduction to Organic Chemistry.* By D. LL. HAMMICK, M.A., Fellow of Oriel College, Oxford. (G. Bell & Sons, 6*s.*)

(*c*) *Fuels and Refractory Materials.* By Prof. A. HUMBOLDT SEXTON, F.I.C., and W. B. DAVIDSON, D.Sc., Ph.D. (Blackie & Son, 12*s.* 6*d.*)

(*a*) The purpose of this volume is to interest the present generation in the early days of science in Oxford, and to this end Mr. Gunther, of Magdalen College, has collected together a great deal of interesting information concerning chemistry that hitherto has been largely scattered.

Roger Bacon, the earliest exponent of experimental science, and a great teacher, worked at Oxford in the thirteenth century. The Hon. Robert Boyle was at Christ Church, and had a laboratory in the High. He brought over from Holland one Peter Sthael, who has the distinction of being the first teacher of practical chemistry. Among Sthael's pupils were Wren, the church builder, "a prodigious young scholar," and John Locke, the philosopher. In the laboratory the latter apparently eschewed his philosophic calm, being "of turbulent spirit, clamorous and never contented," and refused to take any notes of the lectures; he was considered "prating and troublesome." Later, however, he wrote to Boyle concerning experimental chemistry, "I find my fingers still itch to be at it."

It is interesting to know that Oxford had a hand also in early industrial chemistry. John Dwight, of Christ Church, discovered the method of making salt-glazed stoneware in 1661, and some years earlier, Dr. John Wall, of Worcester and Merton Colleges, invented the process of manufacturing Worcester China.

The book is suitably illustrated, and has an appendix of photographs of the chemical apparatus of Dr. Daubeney, who became professor of chemistry in 1822.

(*b*) At the recent meeting of the British Association, Dr. M. O. Forster put forward a strong plea for more recognition of the fundamental importance of organic chemistry, and for the teaching of the subject at an earlier stage than is usually the case at present. For some reason organic chemistry seems to be regarded as an almost sacrosanct subject unfitted for the eyes and ears of youth, and not lightly to be entered upon until the pupil has already mastered the chief points of descriptive inorganic chemistry and the elements of physical chemistry.

Thus it comes about that organic chemistry—the most humane part of the science in that all vital processes and life itself are its special province—is left out of account in the early instruction of the budding chemist; and later, when he is at last introduced to it, he is likely either to be tired of chemistry, or so filled with facts and figures relating to the inorganic and physical branches that he has little interest for the organic branch.

Fortunately, Mr. Hammick has had much opportunity of studying the problem at first hand at Holt School and at Winchester, and, as he is at pains to point out, the book is written not with a view to covering any special syllabus, but in order to introduce to the beginner the idea of structure and to familiarise him with the elementary notation and technique of organic chemistry.

The author assumes, of course, that the reader has an acquaintance with elementary chemistry and with general laboratory operations. After introducing the subject and discussing the question of valency, structural formulæ, and methods of analysis, the book deals with the production and isolation of ethyl alcohol, thence it passes to other alcohols, and so to the discussion of homology, the essential facts of which are very clearly shown in the table on p. 26.

Interspersed in the text are suitable simple experiments which can be readily carried out in the laboratory.

Thence by easy stages the beginner is introduced to the subjects of esters and isomerism. Chapter IV is devoted to the action of sulphuric acid upon alcohol, leading to the formation of ether and ethylene, thus affording an opportunity for discussing saturation and unsaturation. After this the usual derivatives are dealt with, such as aldehydes, fatty acids, ketones, paraffins, amides, etc.; the latter half of the book deals with the aromatic compounds.

The book is essentially readable throughout, and it would be difficult for anyone who has worked carefully through the text and the experiments not to have had his interest and even his enthusiasm aroused for the wonders of organic chemistry. This may serve to carry him forward through the more tedious parts of the subject occasionally met with in the larger textbooks.

(*c*) Dr. Davidson has given Professor Humboldt Sexton's well-known work a thorough revision, and brought it, as far as possible, up-to-date. The earlier editions were found suitable for use as a textbook by students of technical chemistry, and by engineers with a limited training in general chemistry who required a book dealing with the chemistry, and particularly the physical chemistry, of the various kinds of fuels. To these and to students of inorganic chemistry generally this new edition should be of use and value. A. S. R.

AFRICAN EXPLORATION

(*a*) *A Naturalist on Lake Victoria.* By G. D. HALE CARPENTER, M.B.E., D.M., B.Ch., etc. Illustrated. (T. Fisher Unwin, Ltd., 28*s.*)

(*b*) *Exploration of Aïr. Out of the World North of Nigeria.* By ANGUS BUCHANAN, M.C. Illustrated. (John Murray, 16*s.*)

(*a*) Since 1849, the year in which Livingstone discovered Lake Ngami, the vast continent of Africa has tempted many white men to explore and, in some cases, even to settle down in its inner sanctuaries. To those of us who watch from afar, the exploits and work of these pioneers possess a romantic interest quite apart from their results. The heart of Africa has been slowly revealed during the last seventy years. The history of the manner in which its mysteries have been wrested from it is to us as absorbingly interesting as the mysteries themselves, for it shows us the man of civilisation pitting his character against primitive races, against almost insuperable natural obstacles, against terrible climatic conditions and, despite many individual failures, registering a general, though gradual, success. A particularly romantic type in this connection is the one-man pioneer, the man who goes out into the "blue" without a companion except amongst natives, whom he has to dominate or keep friendly by exercising the full powers of his personality. In such characteristics both these books have a common interest, despite the different nature of their subjects.

Even in those regions that have come under the white man's civilisation, much remains to be solved. In this direction Dr. Hale Carpenter has performed splendid service of great benefit to humanity by his lonely and detailed study of the Tse-tse fly and the Trypanosome, that minute unicellular organism which the fly injects by its bite into the blood, thereby causing sleeping sickness. Most of his investigations, extending over a period of three years, just previous to the war, were undertaken on the uninhabited groups of islands in the north-west corner of Lake Victoria, for the Tropical Diseases Committee of the Royal Society.

There are many forms of Trypanosome, and several species of Tse-tse fly. Dr. Hale Carpenter gives an exhaustive, yet easily intelligible and fascinating, account of their activities. But his book provides a wealth of information on the Natural History of the region. Particularly interesting to us was the chapter on Mammals and on the small monkeys of the *Cercopithecus* species, which were of use in his investigations of sleeping sickness, as the malignant Trypanosomes produce the disease in this monkey. Their various gradations of shrieks compose quite a small language, which Dr. Hale Carpenter interprets. He found them the "most charm-

ing companions" during his exile. Another and long chapter on the coloration of insects, with numerous details about protective, warning, and mimetic colours, should prove most valuable to zoologists, as also the succeeding chapter on *Pseudacræa eurytus*, a most remarkable polymorphic butterfly. Of its various mimetic forms, together with model species of another butterfly, *Planema*, two beautifully coloured plates are given. The book also contains a large number of original photographic illustrations.

(*b*) Captain Angus Buchanan belongs more to the class of adventurers and explorers, and though his book abounds with descriptions of many new mammals, birds, and butterflies, its main interest lies in his account of the little-explored mountains of Aïr, that rise in massive, barren, isolated groups out of the level monotony of that part of the Sahara which borders on Northern Nigeria. The author's expedition was undertaken in 1920 in the interests of Lord Rothschild, and its object was to "link up the chain of zoological geography across that portion of Central Africa which lies between Algeria in Northern Africa and Nigeria in West Africa."

The heights of the various Aïr mountain groups range from 3,000 to 5,000 feet. The author found the central group, the Timia Mountains, the most beautiful and fertile, in particular the Timia Gorge, about three or four miles long, "through which the wide shallow river-bed winds . . . while the steep slopes of the majestic heights of Agolak and Timia mountains descend on either side to its very margin, leaving, in places, narrow little stretches of ground upon the banks, no wider than a mansion garden, which are irrigated by means of wells and cultivated by the natives to grow wheat and millet and maize, or bear thick groves of date palms." The northern ranges, to which the French authorities were far from wishing the author to proceed, as they could not guarantee his safety, are far more barren, more sparsely populated, and infested with robber bands, with one of which Captain Buchanan's party nearly came into collision.

The total population of Aïr consists of 5,000 Tuaregs. The account of this branch of an Arab-like Semitic race that has interested anthropologists a great deal in recent years makes one of the most interesting chapters in this book. Captain Buchanan found them "the strangest race I have ever come into contact with—independent, haughty, daring, unscrupulous, and lazy in leisure, yet fit to rank among the finest travellers and camel-riders in the world." The men are of a slim, wiry build, while the women, who do not usually reach more than five feet in height, grow to a moderate stoutness in middle-age. The men, and not the women, wear the *yashmak*, or face-covering, which, though it is a Moslem custom, Captain Buchanan considers has an eminently practical value as well in protecting the face against sun-glare and sand-storms.

E. L.

We regret that, owing to lack of space in this number, we are obliged to reserve, for inclusion in the March number, the considerable amount of correspondence that has reached us.

Books Received

(Books mentioned in this column may or may not be reviewed in this number, or in a later number.)

CLASSICAL LITERATURE

The Legacy of Greece. Edited by R. W. Livingstone. (Oxford: Clarendon Press, 7s. 6d.)

MISCELLANEOUS

The Calendar. Its History, Structure, and Improvement. By Alexander Philip, LL.B., F.R.S. (Cambridge University Press, 7s. 6d.)

The Beginning of the Year in the Middle Ages. By Reginald L. Poole. [From the *Proceedings of the British Academy*, vol. x.] (Published for the British Academy by Humphrey Milford, Oxford University Press, 3s. 6d.)

Up against it in Nigeria. By Langa-Langa. With 47 Illustrations. (London: George Allen & Unwin, Ltd., 18s.)

Oil. Its Influence on Politics. By Francis Delaisi. (The Labour Publishing Company, Ltd., and George Allen & Unwin, Ltd. Paper, 2s 6d.; cloth, 3s. 6d.)

PSYCHOLOGY AND PSYCHICAL RESEARCH

The Psycho-Analytic Study of the Family. By J. C. Flügel. (International Psycho-Analytical Press, and George Allen & Unwin, Ltd., 10s. 6d.) No. 3 of the International Psycho-Analytical Library, edited by Ernest Jones.

The Survival of the Soul and its Evolution after Death. Notes of Experiments by Pierre-Emille Cornillier. (Kegan Paul, Trench, Trubner & Co., Ltd., 10s. 6d.)

SCIENCE

Radiations from Slow Radium and their Therapeutic Value. By John B. Kramer. (Baillière, Tindall & Cox, 12s. 6d.)

Patents and Chemical Research. By H. E. Potts, B.Sc. (Liverpool University Press, 8s. 6d.)

Rays of Positive Electricity, and their Application to Chemical Analysis. 2nd Edition. By Sir J. J. Thomson, O.M., F.R.S. (Longmans, Green & Co., 16s.)

A Textbook of Geology. Vol. I, *General Geology.* Vol. II, *Historical Geology.* By Professor A. W. Grabou, S.B., S.M., S.D. (George G. Harrap & Co., 64s.)

An Introduction to Applied Geography. By Alexander Stevens, M.A., B.Sc. (Blackie & Son, Ltd., 6s.)

Some Factors in Thermal Sanitation in the Tropics. By G. W. Grabham, M.A., F.G.S. [From the *Journal of Hygiene*, January 12, 1921.] (Cambridge: University Press.]

A Star Atlas and Telescopic Handbook. By Arthur P. Norton, B.A. (Edinburgh: Gall and Inglis, 10s. 6d.)

Astronomical Photography for Amateurs. By H. H. Waters. (Edinburgh: Gall & Inglis, 6s.)

DISCOVERY

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Editorial Notes

THE news of the sudden death of Sir Ernest Shackleton came as a grievous blow not only to those interested in polar exploration, but to the whole nation. Apparently, from the report of Captain Hussey, meteorologist to the expedition of the *Quest*, the little vessel during its voyage from Rio de Janeiro to South Georgia came very near to perishing on account of engine trouble in a storm that lasted for several days and was in the late explorer's own estimate "the worst storm he had ever known." Several other serious misfortunes overtook the small crew of the *Quest*, not least of which was a shortage of water, and the intense anxiety caused by these, together with the fact that Shackleton had spent two sleepless nights and days on the bridge, though he had only recently recovered from an attack of influenza, must have had their effect in depriving the expedition of its leader on January 5.

* * * * *

Shackleton was one of those rare spirits who have followed in the wake of Raleigh, Drake, and Frobisher. He was an ideal leader of men, for in addition to the durable courage and imagination of an explorer, he possessed a sympathy which urged him never to give a subordinate a job which he would not do himself, and at the same time showed him instinctively the occasions on which stern discipline was needed. His mantle could not fall to a worthier successor than Commander Wild, a fearless, unselfish sailor, with a wide knowledge of Arctic and Antarctic waters. Such a knowledge is particularly demanded in the work on which the *Quest* is bound. The detection of islands in the Southern Ocean has baffled some of the most able mariners. It is not surprising that many islands have been "found" and "lost" again when one takes into account the poor visibility, the high seas and storms prevalent, and the presence of icebergs apt to be confused with "real" land. The possibilities of new or "lost" lands being discovered in this ocean will be discussed by Dr. R. N. Rudmose Brown, who has had personal experiences of the difficulties involved, in the next number of DISCOVERY.

* * * * *

In a recent number of our contemporary, *Nature*, a curious physiological phenomenon, to which attention was lately directed at a meeting of biologists at Strassburg, is described by Mr. F. C. Dannatt and discussed by Professor Graham Brown. It is illustrated by the following experiment, which may serve as an interesting "parlour trick":

With arms hanging relaxed, stand about eighteen inches to two feet from any solid structure, such as a wall, and face the direction parallel to the wall. Stiffen the arm next the wall and move it away from the body until the back of the hand comes in contact with the wall; stand firm and press the wall as hard as possible with the back of the hand for about fifteen seconds. Now relax the arm, step away from the wall, and this is what will happen:

To the observer's astonishment, his arm will slowly rise, without his making any voluntary effort, until it reaches an approximately horizontal position; it will remain there for a few seconds and then fall back. Whilst the phenomenon is taking place, the observer has the sensation that his arm is raised by an exterior force which is quite independent of volition.

We should add that, in order to obtain the full effect, one should, whilst pressing the wall, press inwards and upwards with such vigour that one can "feel" the muscles of the upper arm. A similar result may be obtained from pressing the back of the hand with

arm outstretched up against the under-side of a mantelpiece or such-like object. A different but rather weaker result, in which the arm will move upwards in front of the body, may be obtained by pressing the back of the hand in a parallel instead of horizontal position against the wall.

* * * * *

This year may be aptly considered as the Centenary of Egyptology,[1] for in 1822 a young Frenchman, Champollion, the son of a bookseller in the Département du Lot, discovered a definite clue to the interpretation of Ancient Egyptian hieroglyphics on the famous trilingual Rosetta Stone. The stone had been found by Napoleon's expedition to Egypt in 1799. In 1802 a Swede named Akerblad had deciphered several words of Ancient Egyptian on the stone, and Grotefend at Göttingen had guessed the names of the Achamenid kings in the cuneiform writings of the Persian Empire; while in 1819 an English physicist, Thomas Young, was able to make partial interpretations of groups of hieroglyphic words. But Champollion, during the ten years that followed his discovery, worked out and published a large vocabulary. The results of his researches, on which a good deal of doubt was cast after his death, were confirmed by Lepsius in France in 1837. The study of Egyptology began to grow apace, and was fostered by the Vicomte Emmanuel de Rougé in Paris, Birch in London, Brugsch in Berlin, Chabas in Châlons-sur-Marne, Goodwin in Cambridge, and Mariette in Egypt.

* * * * *

During the later years of the nineteenth century, and during this century, the development of photography has greatly assisted the efforts of Egyptologists in the work of collation and publication. With the first translations and publications of inscriptions and documents on a large scale, the name of Professor Maspero, who is the Director of Antiquities in Egypt, will always be associated. The other great name that will be associated with the last forty years of Egyptology is that of Professor Flinders Petrie, who inaugurated, and has brought to a high degree of perfection, the work of scientific excavation. Amongst his principal discoveries have been those of the Greek settlements at Naukratis and Daphnæ, a prehistoric Egyptian at Koptos and at Naqada, the kings of the earliest dynasties at Abydos, and the palaces of Memphis. One of his most notable exploits has been the reduction to a minute degree of historical exactitude of the earliest centuries of ancient Egyptian civilisation before written inscriptions had been invented, and his article in this number of our journal deals, amongst other matters, with the methods adopted for this purpose.

* * * * *

There has been considerable talk of late about airship services between Germany and the United States and between Spain and South America. Aeroplane services are rapidly multiplying on the Continent and in the United States; moreover, the safety and comfort of this form of flight have been greatly increased even during the last year. Of particular interest, so far as our Empire is concerned, is the Government's[2] offer to subsidise air companies in Australia willing to operate between Geraldton and Derby (1,195 miles), Sydney and Adelaide (795 miles), and Sydney and Brisbane (590 miles), and the regular weekly aerial mail which our Air Force has been operating since last August on the new route between Cairo and Baghdad. But despite the success of heavier-than-air flight it becomes increasingly apparent that lighter-than-air machines are more likely to solve the problem of linking up our Empire, so far at least as the immediate future is concerned. We were glad to find that the White Paper issued by the Air Ministry last December states that "the potentialities of airships for speeding up communications within the Empire were recognised by the Conference of Prime Ministers held in June–August, and, in accordance with the Government's decision, no steps are being taken in regard to the final disposal of existing airships and material until the Dominion Prime Ministers have had an opportunity of consulting their Governments as to whether contributions should be made towards the commercial operation of Imperial airship services. The airships and material are being stored until these decisions have been communicated." The problem occupied the attention of the Air Conference held from February 6 to 8 last, and a stimulating paper was read thereon by Major G. H. Scott, of the Australian Flying Corps. Most of the airships destined for use on the trans-Atlantic services mentioned at the beginning of this paragraph are being built by German engineers. We have, however, several airships which could be speedily commissioned for Imperial and trans-Atlantic flight, and we feel sure that, given the necessary financial backing, our engineers can produce types of still better design and workmanship than the ones at present in existence.

* * * * *

Certain psycho-analysts would have us believe that the desire to wander, which affects most of us very strongly at some time or other of our lives, and which many a man has taken to his grave, is a "neurosis"—a wish to escape from unhappy surroundings or obliga-

[1] For further information see "*The Times*" *Literary Supplement*, Thursday, February 2, 1922.

[2] See *The Fifth Half-yearly Report on the Progress of Civil Aviation at Home and Abroad* issued by the Air Ministry, December 23, 1921.

tions, or a subconscious fear prompting us to run away from illness. This is a true enough explanation of many cases, but does not apply to the average man. It would be interesting to know how far nomadic tendencies inherited from far-away ancestors account for such a desire—a desire that has produced many beautiful lyric poems, from the spring ode (Carmen XLVI) of the Roman Catullus to one of the last lyrics written by a young poet, E. A. Mackintosh, in the late war, and ending with the lines that express the wish to be one of that band of

> "Lost adventurers, watching ever
> Over the toss of the tricksy foam,
> Many a joyous port and city,
> Never the harbour lights of home."

* * * * *

As individuals we still feel at times the inner call to wander, to open up our horizons, to probe into the unknown, though the tribes and races from which we have inherited the instinct have long since ceased to roam. Even the nomadic Arabs are fast settling down to a more stationary mode of existence, and in Egypt one comes across their new villages on the outskirts of the cultivation of the Nile valley, on the edge of the desert. But the gypsies still continue their wanderings. Besides the many English gypsies in this country, we have it on good authority that bands of "Belgian" and "Servian" gypsies have lately found their way here. In this connection we are glad to hear that the Gypsy Lore Society is resuming its activities. The society was first founded in 1888 by Mr. David MacRitchie "to promote the study of the Language, History, Ethnology, and Folk-lore of the Gypsy Race." It has experienced a somewhat interrupted career owing to lack of funds, but has been set on its feet again by the generosity of a Romani Rai. Mr. T. W. Thompson is the honorary secretary, and we advise any of our readers interested in the society, or wishing to become members, to write to him at Repton, Derby. The first number of the society's new journal, edited by Mr. E. O. Winstedt, contains papers on "Panjābī and Romani Parallels," illustrated by Rumanian-gypsy and Welsh-gypsy folk-tales, and on "The Uncleanness of Women among English Gypsies," which deals with sex taboos likely to be of much interest to anthropologists.

* * * * *

The centenary of the birth of Francis Galton occurred early in February. A cousin of Darwin, and perhaps almost better known during his lifetime for his African explorations than for his biological researches, he is nowadays famous for having systematically attacked the problem of inherited characteristics, and for having thus paved the way to the theory and practice of Eugenics.

The Discovery of History

By W. M. Flinders Petrie, D.C.L., Litt.D., LL.D., Ph.D., F.R.S., F.B.A.

Edwards Professor of Egyptology, University College, London

To most persons the word History will call up the idea of a text-book, shorter or longer, a necessary evil for those who have not the needful time to read at first-hand in the actual authors. To those who look further it will mean standard texts and various readings; to very few will it mean the actual manuscripts from which the material has been drawn. There the chain seemed to end, and, down to two or three generations ago, it was said that nothing could be known except what was recorded by the authors whose works have come down to us.

Gradually the mist has lifted. In place of relying only on the fragmentary accounts of what a few writers thought worth record, we have now a wide view over the details of those ages of literature; beyond that, whole languages and national annals have been read that were but vaguely surmised before; yet, further, the scope of history is now extended to times vastly more remote, and which can only be reached by entirely new methods that have no relation to the traditional materials. The history which was read a century ago, and looked on as the limit of human knowledge we see to be but a fragmentary outline of only a hundredth of the period of man now before our view.

Within the age of classical authors the manuscript material has been greatly amplified by the multitude of inscriptions, the dedications, the decrees, the tombstones, which give first-hand contemporary statements. More detail comes from the great mass of Greek papyri, extending from about 300 B.C. to 700 A.D., which gives the fundamental detail of daily life, of social organisation, and of the carrying on of society. The written record is but one side of this amplification; in the camps, the towns, the cemeteries, we find full evidence of the ways of life, and the intimate personal feeling of style and design, which means so much. Artistic character needs learning, just as a language has to be learned before it can be read; but it is as full of meaning, and of the power of reconstituting personality, as any works of literature. A Pompeian fresco carries as much intimacy of feeling as an ode of Horace, a portrait by Holbein makes us know a character as much as a page of Erasmus or More.

Beyond the home-lands of the Greek world wide countries and long lines of rulers which lay almost outside of literature are now added to our general survey. We could never have understood the Greek

permeation of the East without the coinage of India and Baktria, nor have realised the familiar presence of Indians in the West without the Indian portraits modelled in Memphis. The coins of the Nabathæans, required by those busy traders, show us the importance of feminine consorts among the early Semites, before the blight of Islam. In the Crimea, in Spain, or Gaul, or Britain, we find the active Græco-indigenous civilisation of lines of rulers and city-states, before they went under the overwhelming power of Rome. Little or nothing was known of all this from the tattered remains of authors who were too well satisfied at home to look abroad.

To the classical writer there were various Eastern civilisations going back into a fabulous past, and Belus or Semiramis or Sesostris served as figure-heads in wondrous tales. Two chroniclers—Manetho in Egypt, Berosus in Babylon—gathered an outline of the history from the records of those lands, and what has been preserved to us by chroniclers is a more valuable skeleton plan for placing in order what else we may recover. It is, however, the direct information from the contemporary records that we now rely upon. Within the last hundred years the writings and monuments of Egypt, Babylonia, Sumaria, and Elam have been read and translated ; and recently various outlines of neighbouring tongues have also been partly understood. From this mass of documents we can largely reconstitute the long ages of the changes of civilisation and the movements of peoples. At the present day we have tangibly before us the contemporary objects of half of the kings who are stated to have ruled in Egypt, counting in even the most ephemeral ; or, reckoning by the length of time, we have objects of reigns that cover three-quarters of the whole length of the 5,000 years of that history down to Alexander. When we look at the vast dust-heaps of ancient cities, and think what chance there can be of finding anything of a king who reigned for a year or two many thousand years ago, the recovery of half the names is more than we could expect. The general view that we get is one of incessant turmoil and change. The great and brilliant ages were each of only two or three centuries' duration, and were separated by long ages of decay and of reconstitution. Mankind has been like a beautiful tree, which is mere bare sticks for half its time, and only flowers for a few weeks in the whole year. From classical times we only know of one flowering, and another at the close of the middle ages, with a winter between ; now we can trace eight or nine flowerings and winters, and begin to get a true perspective of the nature of man and his works.

How is this history discovered ? The foundation is formed by the lists of kings ; none of these are complete, but they supplement one another. In Egypt there is the list of the temple of Abydos, complete from the Ist to VIIIth[1] dynasties, and in the XIIth and XVIIIth ; there is the broken-up papyrus list at Turin giving much of the XIIIth and XIVth dynasties, besides earlier portions ; there is the summary of Manetho, which, for the obscure periods, only gives totals. For more detail, there are a few fragments of the yearly annals, kept from the beginning of the kingdom, which show the utmost precision to a single day ; there are various private monuments of officials who lived through several reigns, and recorded their services under each. For the events within a single reign there are many triumphal inscriptions, notices of progress of royal expeditions, and the many small objects commemorative of events, such as erecting great obelisks, or conquering Qedesh, or establishing hunting on horseback, when a larger breed was introduced to replace the small chariot horse.

I write this encamped inside a great fortress built 7,000 years ago, dated by the clay sealings left behind with the king's name ; and I watch hour by hour the clearance of a royal tomb still older, anxiously looking for some object with a name to fix the reign. The skeletons of the royal servants lie before my tent, to be measured and compared with others, so that differences of race may be sought for. The pottery found with them is all compared with types from other tombs that are dated, so that the period of the making may be fixed to within a generation or two. The great flint knife, the gaming pieces, the tomb-stone of a court-carver, the ivory label of a necklace, all tell their own tale of date, and show the state of civilisation. Yet this touches a time which was longer before Moses than we are after him. Evidence does not consist only in large monuments and long inscriptions. A single handful of little things will carry much meaning ; a few badges found at the end of the VIth dynasty and soon after have patterns which are from Mesopotamia and northern Syria, while a cylinder seal shows a Syrian king of Egypt with the same name as in a list of kings of the VIIIth dynasty. Here is a Syrian rule of Egypt, with its own art brought in, and mixing also with Egyptian motives of design. On the other hand, many small points of custom and belief of ancient Egypt are identical in Central Africa now. All this is the material of history.

The term "prehistoric" implies but a narrow view of *historia*. If a connected account of any period can be written, from whatever material, that account is history. If one finds in a house a dead body, a revolver, a strange hat, and a lot of finger-marks, no one doubts that the history of a crime may be written from such

[1] I.e. from about 3400–2460 B.C.. For a note on the dates of the Egyptian Dynasties see Prof. T. E. Peet's article on *The Cit of the Sun-Cult*, in DISCOVERY, vol. ii, No. 22, p. 252.—ED.

material, without a word of evidence in writing to help it. The material evidence is proof enough for writing history, whether of our own day or of past ages. That the material may be incomplete, and not conclusive in every detail, is equally true of nearly all documentary history. In Egypt, what is usually called the prehistoric age, before written documents, has been reduced to historic order nore closely than in other lands. The means for doing this are more complete in detail and quantity than what is recorded elsewhere. A thousand graves, each containing five, or more, varieties of pottery, provided the requisite basis. When all this material was reviewed, it was seen that there was one kind of pot which changed greatly, and the forms of which could be placed in relative order, from a globular pot with wavy handles at the sides, to a plain cylinder slightly enlarging above and below, which was linked to the earliest age of writing. Here was a first step to historic order, but it was only related to about half of the material, and there was evidently a long age outside of this series. The rest of the graves were therefore put in the order of their resemblance of types to those found with the above series ; those with 4 types like those with the series, then 3, next 2, or 1, or none. It was then noticed that another kind of pottery, with white painting, had exactly the inverse relation ; the fewer types like the series, the more frequent types like the painted pottery. This placed the age of the painted pottery as the earliest, then a period with less and less resemblances to that age, and increasing resemblances to the globular pottery, leading to the series of changes from globular to cylindrical forms. Thus the whole of the pottery before written history was put roughly into order.

Each form being numbered, the next step was to write on a slip of card the numbers found in one grave ; on putting these slips in the probable order of the pottery, the extent of range of each number was looked for, and the earliest and latest examples were brought nearer together, if they did not spread other types farther apart. In short, the aim was to find the order which should give the most compact extent for each type, as this was the more probable condition. The thousand graves, as thus restored to probable order, were divided into fifty equal sections, which were numbered, and the range of each pot-type was stated, such as 35–38, or 44–46. These numbers only show the order of age, and not an equal scale of time ; hence they are called *sequence dates*, and all the products of the ages before writing are dated now as S.D. 40, or whatever may be the number in the scale. This is as definite as dates B.C. or A.D., but the unit is much longer, perhaps a generation rather than a year. History, as meaning a definite order of events, can now be carried back in the unwritten ages through two whole cycles of civilisation, covering probably two or three thousand years. The first cycle was derived from Algeria, or the West, it rose to widespread unity over the whole land, and showed more artistic work than the second age, but less use of fine and hard stones. All through it there was a slight infiltration of an entirely different pottery ; this suddenly came into full use in the second civilisation which entered from the East, and excelled in mechanical work. To this second age belongs the series of pots from globular to cylindrical named above ; traces of a new people were gradually appearing, and after the decadence of this age there burst in the full civilisation of a short and vigorous people, which seems to have come from Elam, bringing entirely new ideas, and starting the course of written history.

A similar study of other lands would lead to more definite and historical relations in the age before writing. For instance, in Britain a sequence of development in the bronze age pottery points to the earlier immigrants arriving in Yorkshire and Dorset rather than at the narrows of the Channel. This implies that they were a seafaring people, and that the Continental culture was stronger in Kent, and could resist invasion ; also that the invaders were not in occupation of the Calais-Boulogne coast.

In many minds the question will arise, " What is the use of tracing these remote changes, how can they have any bearing on our present ideas in a vastly different state of society ? " Let us look at the matter from its purely material side, ignoring the question of the higher values of mental training and outlook. The material aim of history is to know the biology of civilisation, and to distinguish cause and effect. We have to separate and realise what are the social, political, economic, and ideal elements in the rise and in the fall of civilisations. Where we had only one cycle before us in history, it was almost impossible to settle between cause and effect. When we have eight or nine cycles before us, and can compare the details in several of them, it becomes clearer how various movements are connected. Was Diocletian's [1] edict of prices the cause, or the concomitant, or the result, of the decay of the Empire ? To judge of this, we must observe what there is in common in the times of Khammurabi,[2]

[1] Diocletian shared with Maximian the emperorship of the Roman Empire from A.D. 284–305. An edict issued by him, regulating the wages of all grades of labour and the prices of goods and commodities throughout the Empire, was discovered at Stratoniceia in Asia Minor by Colonel Leake in the middle of the nineteenth century.—ED.

[2] Khammurabi, a Babylonian king, who reigned about 2000 B.C. A black marble pillar inscribed with the code of laws drawn up by him and regulating every detail of civilised life was discovered at Susa (Khuzistan, Persia) in 1902 by Monsieur de Morgan.—ED.

Diocletian, and in more recent experiences, in all of which there was regulation of prices. Khammurabi's law was evidently a compromising of two different systems, the city and the pastoral life. Diocletian's law was at the junction of free outstanding peoples reacting on Roman life, influenced also by the degradation of currency. Our experience in the middle ages was where city life became centralised, and could not provide its own food, so that the separate country life interacted on it irregularly. Our recent war experience is where the free flow of trade was interrupted, and foreign supplies were intermittent and not subject to free supply and demand, thus giving back to the interaction of two separate systems, external and internal. Such seems to be the cause of price-regulation ; but it can only be a very brief phase, just so long as supply is automatic, for it quickly destroys supply and suppresses demand.

Another question to be answered : Are we to regard the infiltration of a people into another country as preparatory to general invasion ? The fall of the first prehistoric civilisation was long preceded by the infiltration of the second people. A similar change preceded the fall of the second people ; also the Syrian break-up of the VIth dynasty, the Hyksos invasion, the Greek occupation, and the Arab conquest of Egypt, the Germanic conquest of Rome, the Saxon settlement of England, and the Danish occupation of England culminating in the Normans. A migration-conquest (in contrast to a political conquest) appears to be usually preceded by centuries of individual entry and settlement. Let us beware of systematic infiltration by other nations.

Comparative history is necessary for us to realise that no civilisation is influenced by an inferior, but only by a civilisation which is equal or superior in some respect. We see, in the past, Elam strongly dominating in Mesopotamia and in Egypt ; Syria permeating Egypt in the XVIIIth dynasty ; Perso-Roman work modifying China in the Han period ; China dominating Japanese life ; Gothic art ruling even in the Forum of Rome under Theodoric[1] ; Japan influencing European work now. In each case there are qualities in the new influence which are superior to—or lacking in—the existing system.

As in organic life we realise more and more how essential it is to study the life-cycle of each organism, if we would understand its real conditions, so in the biology of civilisations we must study their life-cycle of birth, growth, and decay, if we would know the cause of changes, and the meaning of the present world around us. This is history.

[1] Theodoric, leader of the Western Goths, conquered Italy, A.D. 489.—Ed.

Our Neighbour Worlds

By the Rev. Hector Macpherson, M.A., F.R.A.S., F.R.S.E.

II. THE GIANT PLANETS

The four giant planets may be conveniently divided into two sub-classes. The first is composed of Jupiter and Saturn, by far the largest bodies in the Solar System, with the single exception of the Sun—planets which were first recognised as such in prehistoric times ; while the second group consists of Uranus and Neptune, which, though undoubtedly belonging to the category of giant planets, are considerably smaller, and whose existence was unknown till less than a hundred and fifty years ago.

The study of Jupiter dates from the time of Galileo, whose most striking telescopic discovery was that of the four large satellites of the giant planet in January 1610. His telescope was not powerful enough, however, to reveal any markings on the Jovian disc, and it was not till 1630 that Zucchi, an Italian observer otherwise unknown to fame, first noticed the parallel lines since known as the belts of Jupiter. Thirty-four years later a still more significant discovery was made, when the English astronomer, Hooke, detected a small spot which he perceived to be in motion. His suspicion that this indicated a rotation of Jupiter on its axis was confirmed in 1665 by Cassini, who determined the period as 9 hours 55 minutes, which, like most of Cassini's determinations, was a remarkable approximation to the truth.

The first interpretation of the Jovian markings was put forward by Sir William Herschel in 1781. In a paper on the rotation of the planets on their axes he threw out the hint that the belts represented currents in Jupiter's atmosphere, somewhat analogous to the terrestrial trade-winds. This view was in harmony with Herschel's general conception of planetary conditions. To him it was an axiom that our neighbour worlds were "richly stored with inhabitants," and thus he was led to interpret his observations of Jupiter in the light of the hypothesis that the great planet was simply an immensely larger edition of the Earth. During the greater part of the nineteenth century this view of Jupiter prevailed, and was accepted by most of the popular writers on astronomy. J. P. Nichol, for instance, interpreted the spots as mountains, in keeping with the current view, which was held also by Sir John Herschel.

There had been, it is true, doubts as to the validity of the parallel drawn between Jupiter and the Earth. Buffon in 1778, and Kant in 1785—neither of them astronomers—had suggested that Jupiter was still in a state of great internal heat, and the same suggestion

was made by Nasmyth in 1853. But it was not until 1865 that the evidence adduced by Zöllner, of Leipzig, convinced the contemporary astronomers that Jupiter was no enlarged edition of our own world, but was, indeed, a semi-sun. Zöllner drew attention to the rapid changes in the cloud-belts both of Jupiter and Saturn. Such changes, he showed, indicated clearly a high internal temperature for both planets, for the heat of the Sun at the distance of Jupiter is quite incapable of causing atmospheric disturbances on so vast a scale. Zöllner drew attention, too, to another analogy between Jupiter and the Sun, namely that the planet, as Herschel had noted long before, does not rotate as a whole, but that the rotation is accelerated in the equatorial regions. Clearly this fact conflicted directly with the current theory of the planet's physical condition. The new view of Jupiter and of the giant planets in general was adopted by the late R. A. Proctor early in his career, and presented with convincing logic in 1870 in his classic volume, *Other Worlds than Ours.* "If analogy is to be our guide," he wrote, "and we are to judge of the condition of Jupiter according to what we know or guess of the past condition of the Earth and the present condition of the Sun, we seem led to the conclusion that Jupiter is still a glowing mass, fluid probably throughout, still bubbling and seething with the intensity of the primeval fires, sending up continually enormous masses of cloud to be gathered into bands under the influence of the swift rotation of the giant planet." The conception of Jupiter as a body, half sun, half world, has never since been challenged.

In the seventies a new period in the study of Jupiter was inaugurated, which may be called the period of intensive observation. The discovery by Niesten at Brussels, in July 1878, of the remarkable object known as the "great red spot" gave an impetus to much more detailed study of the spots—both bright and dark—and the more delicate detail on the Jovian disc. Eminent observers such as Keeler, Lowell, and Barnard have kept the planet under observation with the aid of the most powerful telescopes; and in addition a great deal of important information has been collected by several non-professional astronomers, among whom must be specially mentioned Messrs. Denning, Stanley Williams, Phillips, Molesworth, and Bolton. Denning's patient study of the great red spot has shown that it was probably visible long before 1878; he believes it to have been seen by Schwabe in 1831, and probably by Hooke in 1664. The long-continued work of Mr. Stanley Williams indicated to that astronomer in 1896 the existence of nine different currents in the Jovian atmosphere, made manifest by the different rotation-periods obtained from observations of spots in the various latitudes. In 1901 Molesworth, observing in Ceylon, was the first to catch a glimpse of the beginnings of the "southern tropical disturbance," which has been conspicuous on the disc for the past twenty years. Another significant discovery, due to Mr. Scriven Bolton, was abundantly confirmed by Professor Lowell at the Lowell Observatory. Mr. Bolton detected "wisps" or "lacings" extending across the bright equatorial belt, and Lowell pointed out that these strips are not confined to the equatorial belt, but are to be seen traversing all the bright belts right up to the poles.

Several attempts have been made in recent years to correlate in a general theory of the planet's constitution all the isolated facts which have been ascertained during the past half-century. The late Danish astro-

JUPITER, FEBRUARY 17, 1906.
From a drawing by the Rev. James Baikie, Edinburgh.

nomer, H. E. Lau, of Copenhagen, put forward shortly before his premature death a theory of the planet based on his own observations. The true surface of the planet, he maintained, consists of a bright yellow cloud envelope, highly reflective, enveloped in a much thinner atmospheric stratum. The equatorial zones he believed to be spot-zones, the belts consisting of dark spots. "The bright spots are apparently clouds overlying the hottest places. Their brightness varies with the sun-spot activity, so that a periodic change of brightness in the planet is produced. The red spot is an abnormally heated region in the deeper strata of the gaseous envelope." This does not conflict with Lowell's view that the red spot is due to "a vast uprush of heated vapour from the interior . . . a sort of baby elephant of a volcano, or geyser, occurring as befits its youth in fluid, not solid conditions, but fairly permanent nevertheless—a bit of kindergarten Jovian geology."

The colour of the spot was held by Lowell to indicate that "in such places we look down into the fiery, chaotic turmoil incessantly going on"—a view held also by Denning. Some authorities maintain, however, that nothing but cloud is visible—that we cannot even glimpse the true Jovian surface; on the other hand, Barnard has recently expressed the view that the surface we see is not exactly a cloud surface. "The appearance is more that of a pasty nature."

Recent research has undoubtedly emphasised the analogy between Jupiter and the Sun. Lau, in his theory of Jupiter, suggested that the rapid rotation of the planet is the explanation of the existence of continuous belts in place of isolated spot-groups such as are seen on the slowly-rotating Sun. That the red spot is akin to sun-spots has been recognised for many years. As long ago as 1879, the Russian astronomer Brĕdikhine noticed a group of objects resembling the solar faculæ encircling the spot. Phillips inclines to the view that "the red spot is a vortex—analogous to a cyclone on the Earth, though its prolonged existence shows that it must be of great strength and probably deep seated below the planet's visible surface." "We might indeed expect many vortices to occur along the lines of contact between viscous currents possessing diverse velocities, and if many of the Jovian spots are of this character, we have another analogy between Jupiter and the Sun." Amid considerable diversity of opinion regarding the finer detail on the disc of Jupiter, it may be said that the work of the last two generations has abundantly confirmed the view that Jupiter, in common with the other giant planets, is in a state of primeval chaos. As Barnard remarks—"They are the worlds of the future. Perhaps millions of years hence they will be discussing the possibility of life on the Earth—if they ever know of its existence—or whether life ever existed there."

All that is known of Saturn, Uranus, and Neptune abundantly confirms this view. The belts of Saturn are fainter and less conspicuous than those of Jupiter, solely because of the much greater distance at which that planet revolves. Doubtless, the relative scarcity of spots is due to the same cause. It was not until 1794 that the appearance of a Saturnian spot gave the clue to the period of rotation. In that year Herschel perceived one, and from its motion fixed the length of the planet's "day" at 10 hours 16 minutes. This period was more or less confirmed by Hall at Washington in 1876, and later by Denning and Stanley Williams. A bright spot noticed by Barnard at the Yerkes Observatory in 1903 indicated a considerably longer period, 10 hours 39 minutes, a fact which demonstrates that Saturn, like Jupiter, does not rotate as a whole.

Saturn resembles Jupiter not only in the broad general features of its disc, but in the more intricate detail as well. Highly significant was the discovery by Lowell of "wisps" similar to the wisps of Jupiter—"filamentous streaks between the belts, sometimes vertical but more often inclined, after the manner of the lacings of a sail. Individually they resemble distant droppings of rain from a storm cloud seen slanting against the sky under the force of a strong wind. At first they were described only across the light equatorial zone, but have since been seen meshing the whole surface of the disc."

From the Lowell Observatory came in 1912 the announcement of the successful measurement of the rotation-period of Uranus. Perrotin and Thollon at Nice in 1884 believed that they had evidence of rotation in about ten hours, but little confidence was reposed in their result because of the extreme faintness of the Uranian markings. Accordingly, to Dr. Lowell and his assistant, Dr. V. M. Slipher—now director of the Lowell Observatory—belongs the honour of ascertaining the period. The problem was attacked spectroscopically by means of Doppler's principle, and the planet was found to rotate on its axis in a period of 10 hours 45 minutes in a retrograde direction.

Dusky shadings—presumably belts—have been glimpsed from time to time on the sea-green disc of Uranus. They were glimpsed by Young at Princeton, New Jersey, in 1883, and were distinctly visible to the French astronomers, the brothers Henry, at Paris in 1884. The detection of markings on Neptune is due to the distinguished American astronomer, Dr. T. J. J. See. On October 10, 1899, he noticed some belts on the disc very faint and indistinct. Telescopic observation indicates that Uranus and Neptune are physically similar to the two larger planets. To the spectroscope, however, we owe the greater part of our knowledge of the two outermost worlds of the Solar System. In 1902 Dr. Slipher began his investigation of the spectra of the four giant planets at Flagstaff. His photographs showed that the spectra of Uranus and Neptune are much more complex than those of Jupiter and Saturn, and indicated the existence of elements unknown or unidentified upon the Earth. The atmospheres of the two outermost planets would appear to be very extensive. In the case of Uranus, Lowell reached the conclusion that in that planet "we see a body in an early amorphous state, before the solid, the liquid, and the gaseous conditions of matter have become differentiate and settled each into distinctive place. Without even an embryo core its substance passes from viscosity to cloud."

The giant planets differ from the dwarf in the possession of important and genuine systems of satellites. The Earth-Moon and the Martian systems both appear to be somewhat sporadic cases, out of the regular course of evolution. The genesis of the Moon, as Sir

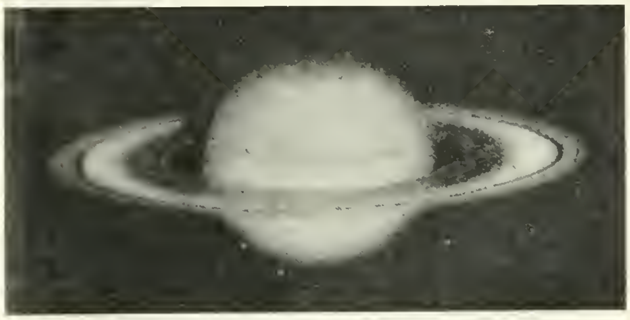
G. H. Darwin's researches indicated, was possibly unique; while the satellites of Mars are bodies so closely resembling the asteroids that it is by no means improbable that Mars was at one time moonless, and that the little attendants were originally asteroids which came too near to the red planet at some epoch in the distant past. But the satellite-systems of the outer planets are of a different order. The four large satellites of Jupiter are in point of size but slightly inferior to the inner planets, and only their great distance from us renders them more or less enigmatical objects. The largest telescopes in the world have been employed on these satellites from time to time, but authentic information concerning them is scanty. Polar caps, dusky markings, and canaliform appearances have been glimpsed, but the evidence is conflicting. More certain is the fact—which Herschel, with his quick insight, perceived over a century ago—that each of the four moons completes its rotation in the same period as its revolution and turns the same face constantly to its primary, just as the Moon does to the Earth and Mercury does to the Sun.

Probably no discovery in recent years was so totally unlooked-for as that of the tiny fifth satellite of Jupiter by Barnard at the Lick Observatory in September 1892. For nearly three hundred years the Jovian system had been regarded as complete—as a perfectly harmonious and symmetrical system. The tiny moon, no more than 100 miles in diameter, whirling round its primary in a period of 11 hours 57 minutes at a distance of 112,000 miles seemed strangely out of place among the larger satellites, and the suggestion was hazarded by Sir Robert Ball that it was only the first of a number of small satellites. Four other moons have since been detected, two by Perrine at the Lick Observatory in 1905, one by Mellotte at Greenwich in 1908, and another by Nicholson at the Lick Observatory in 1914. These objects—so faint as to be detected only by their images on the photographic plate—are akin to the fifth satellite in size, but not in distance; for the sixth and seventh moons are about seven million miles from Jupiter, and the eighth and ninth—which revolve in a retrograde direction—about eighteen million. The idea is at once suggested that these tiny Jovian satellites are captured asteroids, and that the four large moons are the only original members of the system. Be this as it may, there can be no doubt that the satellites of Jupiter fall into two well-defined groups—giant and dwarf moons.

The same cannot be said of the Saturnian system. The ten satellites of which that system is composed are of various degrees of brilliance and presumably of different sizes. Titan, the largest, is of the same order of size as the Jovian moons; it was discovered by Huyghens as long ago as 1655. Of the others, four were detected by Cassini in the seventeenth century, and two by Herschel in the eighteenth. In 1848 came the discovery of Hyperion, the eighth; while Professor W. H. Pickering detected Phœbe in 1898, and Themis in 1905 by means of the photographic plate. Like the distant satellites of Jupiter, Phœbe moves round its primary in a retrograde direction. Apparently most of Saturn's satellites turn the same face to their primary.

That Uranus and Neptune possess other satellites than those at present known is highly probable. The four Uranian and the one Neptunian moon are relatively large satellites; and it is not improbable that both these worlds possess smaller and fainter moons, which will be revealed in the future by the aid of the camera.

The system of Saturn is unique in the existence of the wonderful rings. The ring-system was one of the earliest telescopic discoveries. Huyghens in 1656



THE PLANET SATURN AND ITS RINGS.

detected the curious formation which baffled Galileo; and Cassini, one of the keenest observers who have ever lived—discovered the existence of the division in the ring known by his name—in other words, found that there existed not one ring, but two; while a third, the "dusky" ring, was discovered in 1850 by Bond, of Cambridge, U.S.A., and independently by the English astronomer Dawes.

The earlier astronomers proceeded on the assumption that the rings were exactly what they seemed to be—solid structures, and it was not till the middle of the last century that the mathematical analysis of Roche of Montpelier, and later of Clerk-Maxwell, demonstrated that they were neither solid nor fluid, but composed of myriads of meteorites, or "brickbats," as the latter mathematician designated them. The meteoritic theory of the rings received a triumphant verification when in 1895 Keeler, by means of Doppler's principle, succeeded in measuring the rates at which the inner and outer rings revolved round Saturn.

The late Professor Percival Lowell commenced, early in the present century, an exhaustive study of the ring-system. His scrutiny was rewarded when in 1907 he made the highly important discovery of the knots or

beads on the rings—obviously particles pulled out of the plane of the rings by some external influence. Lowell's later mathematical analysis showed that both the gaps in the ring and the knots were due to the pull of the several satellites. "We find," he wrote in 1910, "that Mimas, Enceladus, and Tethsy have periods exactly commensurate with the divisions of the rings; in other words, these three inner satellites whose action because of proximity is the greatest have fashioned the rings into the three parts we know."

Obviously the ring-system represents a satellite spoiled in the making, and evidently the rings are analogous to the asteroidal zone in the Solar System. In the case of the asteroids, the proximity of the huge mass of Jupiter evidently prevented the formation of a planet of any considerable size. In the case of the Saturnian rings, no satellite could be formed at so small a distance; and thus we have what is to all intents and purposes a meteor stream—myriads of minute stones and particles closely packed together which at the enormous distance of nearly eight hundred millions of miles from the terrestrial observer appear as an annulus of "immaterial light."

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Immunity in Infectious Diseases

By A. E. Boycott, M.D., F.R.S.

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EVERYBODY knows, as a matter of domestic experience, that children who have had measles or chicken-pox are very unlikely to have a second attack of the same disease, and that, when the puppy is through with its distemper, there is no substantial chance of its having it again. It is familiar, too, that an attack of measles does not protect against chicken-pox, or scarlet fever, or German measles, or, indeed, any infectious disease except measles, and that distemper is no preventive of worms or mange. Most people are also prepared to agree that vaccination is a fairly good insurance against small-pox, and that antityphoid inoculation improves one's chance of avoiding typhoid fever. In the former case the vaccine lymph which is scratched into the skin causes a mild attack of small-pox as it occurs in the cow; in the latter instance dead typhoid bacilli are injected under the skin. Here, again, vaccination is no protection against typhoid, nor is antityphoid inoculation of any value in escaping small-pox. It appears, therefore, that an attack of an infectious disease either naturally occurring or artificially induced, or a dose of the organisms which are the cause of the disease, may bring about a definite change in the constitution of the body. This resistance, or *immunity*, holds good only for the particular infection which originates it; it is, in other words, "specific." It varies in intensity in different individuals and with different diseases, being almost absolute in the case of chicken-pox, relatively slight in that of the common cold. It lasts, too, for varying times, the tendency being always for it to diminish progressively: soon after the 1918–19 influenza epidemic, most people who had had an attack could count on not having a second one; but recent experience indicates that this resistance has now largely faded away. Probably a more important fact to realise is that immunity is not acquired at once. If it were, it would be difficult to understand how infectious diseases so often run their characteristic courses, and end in recovery. Generally speaking, resistance does not develop till about ten days after the beginning of an attack of infectious disease or the infliction of vaccination. For the substances which are introduced into the economy in antityphoid inoculation do not in themselves directly help the body to resist the typhoid bacillus. They are not like the doses of quinine, which, with luck, will protect against malaria; quinine is itself poisonous to the malarial parasite, and is efficacious directly it has entered the body. These dead bacilli, on the contrary, act by stimulating the body to set its tissues to do things which are injurious to the bacteria: antityphoid inoculation or vaccination or an attack of measles only help the body which is prepared to help itself. And the changes in resistance which these experiences of infectious micro-organisms bring about are simply the changes which practice will cause in any organ of the body. A man who has never been in any relation at all to a disease-producing micro-organism will have a certain amount of ability to resist its first attack on his person: resistance may be small or it may be considerable, but there will always be some, for no infectious disease kills all the people it affects. But, once anybody has successfully resisted an invasion by bacteria, his tissues profit by the experience they have had, and are in a better position to resist a second or subsequent attack, just as any bodily action can be trained and improved by practice.

Bacteria are harmful to the body because they produce poisonous substances, not of malice but by chance. The enormous majority of bacteria excrete nothing which is manifestly injurious to the higher animals, and it appears to be accidental that the waste products of a few of them are among the most poisonous substances known. These poisons belong to the class of complex nitrogenous substances found in live things known as proteids, and are similar in character to a number of other poisons produced by higher animals and plants, as, for example, snake venom, spider poison, and the ricin present in castor-oil seeds. Their precise chemical constitution is not yet known, and none of them have been made artificially. The whole class of proteid poisons have this peculiarity, that they reproduce the phenomena of immunity or resistance to infectious diseases. Thus an animal given a dose of the poison produced by the diphtheria bacillus, or of cobra venom, or of ricin less than that necessary to kill it, acquires resistance, not to proteid poisons in general, but to the particular poison with which it has been treated. Starting with small doses and gradually increasing them week by week, it is possible in this way to prepare an animal so that it will tolerate several thousand times the quantity of poison which would kill it in its natural untreated state. Nothing of the kind happens with simpler poisons of known chemical composition, whether organic such as morphia or hyoscine, or inorganic such as arsenic. It is true that experience enables us to smoke without being sick, that assiduous practice enables people to consume surprisingly large quantities of morphia with relative impunity, that girls in the Tyrol are said to eat arsenic like salt to improve their complexions. But closer examination shows that these habituations are of quite a different order from the immunities which are produced to proteid poisons. The largest dose of morphia which de Quincey could take is by no means necessarily a fatal dose for a normal person without previous experience of the drug, and careful experiments have failed to train animals to withstand more than about one and a half times the fatal dose of alkaloids, such as nicotine and morphia: there is no real reason to suppose that the girls in Styria (Austria) can take more arsenic without ill-effects than girls from Stafford. That proteid poisons had these special and peculiar relations to the animal body was one of the great biological discoveries. Who made it cannot be precisely affirmed, for discovery is a process and not an event; but Sir Thomas Frazer, of Edinburgh, had a great deal to do with its precise formulation.

Further inquiries have, indeed, shown that the reactions aroused by these proteid poisons depend on their being proteids rather than poisons. Analogous phenomena occur when the white of a hen's egg is introduced into a rabbit or an extract of cabbage leaves into a guinea-pig. These substances are not poisonous in any ordinary sense of the word, but they produce the same type of reaction as do the proteid poisons, as can be demonstrated in a variety of ways appropriate to each particular case. As far as we know, any proteid will initiate the response if it is "foreign," and if it reaches the tissues of the animal in an unaltered or "native" state. And each kind of animal treats as "foreign" the proteids of any other species, and by digestion so decomposes them that they cease to be "native" and lose their foreign characteristics. Ox blood, for example, is foreign if it is injected under the skin of man, but not if it is injected into a cow. If man eats it in a sausage his digestive juices break it up, so that, when the remains are absorbed into the blood and reach the tissues, they are no longer recognised as bovine in origin, and are not treated as foreign. The parasites which cause infectious diseases are always of different species from the hosts whose bodies they invade: hence, they are always liable to set up this peculiar reaction to foreign proteids, among which, in this particular connection, the poisons are the most conspicuous.

What, then, does the body do to defend itself against these poisons produced by bacteria and other parasites? Its activities run along two main lines. In the first place it deals or tries to deal directly with the poison by producing substances which combine with the poison and render it inert and harmless, just as alkali will neutralise an acid and remove its caustic qualities. These substances are known as "antitoxins," because they neutralise the poisons or "toxins"; in more general terms they are "antibodies," i.e. proteid substances produced by the tissues in response to foreign proteids or "antigens." Antitoxins are found in the blood of animals which have acquired resistance to a proteid poison. Thus, if a horse is treated with gradually increasing doses of the poison produced by the diphtheria bacillus till it will tolerate much more than the quantity which would originally have killed it—or, to use a more technical phrase, it has been immunised to diphtheria toxin—it will be found that its blood will neutralise diphtheria toxin in a test-tube outside the body, so that, when the mixture is injected into a guinea-pig, it does it no harm. The same blood will neutralise the same toxin when it is being produced inside an infected animal by the diphtheria bacillus, and is used with considerable success in the treatment of diphtheria in man. Similarly the blood of a horse (or any other mammal) immunised to cobra venom will neutralise cobra venom, and so forth. But the parallel with ordinary chemical "neutralisation" holds no longer. For, while any alkali will neutralise any acid, an antitoxin will neutralise only the toxin which has stimulated its production, just as measles protects only against measles.

In the second place, the body attacks the parasite which is producing the poison in a variety of ways which may be conveniently grouped under two main headings. Firstly, the tissues are stimulated by the proteids of the bodies of the parasites to generate various substances which have influences on the parasites. These antibodies are found in the blood like antitoxins. Some of them dissolve the bodies of the parasites, some so alter the surface of the bacteria that they run together into masses, as would inorganic particles of comparable size, some form obvious precipitates with the bacterial proteids ; one way and another the antibodies are unfavourable to the parasites. Secondly, the tissues are stimulated to destroy the parasites by eating and digesting them as an amœba eats a diatom. The cells in which this capacity for what is technically called "phagocytosis" is most highly developed are partly fixed cells in and close to the blood and lymph channels, and partly the wandering cells, or leucocytes, which move freely in the blood stream, and actively crawl about in the tissues of their own proper movement. The realisation of the important part which this process plays in the defence of the body was the great contribution of Metchnikoff[1] to biology ; with the fundamentals of our knowledge of the unorganised antibodies we associate the name of Ehrlich.[2] The two points of view, for long treated as divergent, found a harmonious meeting-place in the discovery that among the antibodies are substances which combine with bacteria, and so render them more susceptible to phagocytosis.

It is important to realise that these phenomena also are not peculiar to harmful parasites : the reactions in disease are simply a special case of general reactions to cells from other species of animals and plants. If a guinea-pig is inoculated with typhoid bacilli, which are harmful to it, it will develop the various sorts of antibodies which have been indicated, and its wandering cells will eat the bacteria ; it will do the same if it is dosed with some harmless bacillus, or with the innocuous particles of brown pigment which colour the hair and skin, or with the red blood corpuscles of some other species of animal. These are all foreign bodies. But, if it is given its own blood corpuscles or those of another guinea-pig, it treats them as harmonious to its economy and takes none of these steps to attack them. What happens to a parasite, then, happens simply because the parasite is not the same kind of live thing as the host. And if Linnæus[3] had known of these modern elaborations of his passion for putting the world into a tidy and orderly arrangement, he might well have knelt down in a laboratory, instead of on Berkhamsted Common, and thanked God for making the world so beautiful.

It seems, therefore, that these reactions are a general proposition as regards the relation of the lowest forms of animal and vegetable life to mammals and birds, and of the different kinds of mammals and birds to one another. For the great bulk of our knowledge has been derived from experimental studies in these fields. It is reasonable to suspect that the proposition might well extend so as to include the relations of all forms of live things to one another—that, for example, if a mammal stimulated by a bacillus produces an antibody, so the bacillus stimulated by the antibody (which is to it a foreign proteid) will produce an anti-antibody. It is, fortunately, unnecessary to think about the ultimate complications of an action and reaction of this sort, because there are no reasons to think that the first step actually occurs. Bacteria, it is true, take steps to withstand antibodies and phagocytosis, but they proceed by an entirely different method. Like other small organisms, bacteria occur in enormous numbers and multiply very rapidly. If you are counting bacterial populations, 1,000 millions is a convenient unit with which to work, and any ordinary laboratory culture may contain a good many of these units in a few cubic centimetres · under favourable conditions a single pair of rats will increase to some 200 in a twelvemonth, while a single bacillus may become about 8 million in twelve hours. The importance of these features of bacterial populations is this. The larger the absolute numbers of organisms, the more likely it is that a given population will contain individuals in which fluctuating characters are most highly developed. Just as a giant or a saint is more likely to be found in a town of a million inhabitants than in a village with a hundred, in Manchester rather than Toller Porcorum, so individual bacteria with a giant capacity to resist phagocytosis and antibodies are commoner than individual men with an exceptional capacity to resist bacteria, simply because the bacteria are infinitely more numerous than the men. The body of a person with typhoid fever contains many more typhoid bacilli than there are people in the British Isles. Using the advantages which their numbers give them, the bacteria do nothing

[1] Elie Metchnikoff (1845–1916), Russian zoologist to whom, in 1883, first occurred the idea that the eating of foreign microbes by the cells of the body might be a defence against disease (a process for which Claus, of Vienna, invented the word *phagocytosis*). In 1888 he joined Pasteur in Paris and worked there till his death. See the splendid *Life* by his wife (Constable & Co., 1921).

[2] Paul Ehrlich (1854–1915), German pathologist who, with the Belgian Bordet, is chiefly responsible for the fundamental experiments on which is based our knowledge of the formation of antibodies and their mode of action.

[3] Carl von Linné (1707–1778), Swedish naturalist who reduced the animal and vegetable kingdoms to order, systematically described them, and devised the methods of classification and nomenclature now in use.

as regards individual resistance, but trust that their billions will include a few individuals which can successfully withstand the attacks made by the host: from these survivors a fresh population can be generated in a time which is very short on the scale used by the host, and this new population will have the special properties of resistance of its progenitors. It would be impossible for a relatively sparse, slowly-multiplying animal like man to proceed along these lines with any chance of success in competition with bacteria. The breeding out of selected races has, of course, happened in man and the higher animals. Infectious diseases are constantly killing off the more susceptible individuals, and raising the average resistance of the population, but the process is painfully slow. In India, for example, plague has killed a pretty substantial proportion of the human and rat populations since it reached Bombay twenty-five years ago. Any increase in human resistance to plague can only now be just beginning, and is certainly at present imperceptible. It is known, however, that the resistance of the rat population of India to plague was very much increased ten years ago, and the plague bacillus is no doubt constantly engaged in breeding out resistant races every week during the epidemics. But higher animals have had to supplement race resistance by individual resistance, and the latter becomes progressively more important as species become larger and hence less numerous and more slowly multiplying. Sick men are characteristically individualistic in their outlook, and it is from their point of view that the problems of resistance have been mostly examined.

Taking such a survey of the animal series as our ignorance allows, it seems as if the production of antibodies appears as a regular procedure only among mammals and birds. It may well be that this is associated with the greater powers of multiplication enjoyed by parasites living at the high temperature of warm-blooded animals. Among cold-blooded vertebrates and invertebrates the production of antibodies seems to be weak and occasional, often absent altogether. Phagocytosis, on the other hand, occurs freely and universally except amongst animals that are so simple that it is hardly possible for anatomical reasons; it is evidently a fundamental and primitive mode of resistance to any particulate foreign matter. The capacities for multiplication of all these lower animals and their numerical abundance are in general substantially and often immensely greater than those of mammals and birds; an oyster produces anything from 1 to 100 million young in a year, and oysters are content to rely on their numbers and their few exceptional individuals to pull them through, which is more than man does when he sees the results of the census.

Plants, which are subject to a number of diseases due to bacteria and more caused by fungi and other parasites, proceed on somewhat similar lines. There is no satisfactory evidence of antibody formation or of phagocytosis. In many cases their resistance is on the surface in the form of coatings of wax and other things which make it difficult for the parasite to get inside. In other instances, parts of the plant which are infected are discarded, e.g. the leaves in hollyhock disease. Of any active opposition to a parasite, once it has gained entrance, there is very little evidence, and the average plant relies for its survival—i.e. the survival of its race—on its powers of multiplication. The number of seeds may be very large; a plantain produces only some 14,000. In many cases this is supplemented by other modes of non-sexual growth, such as underground tubers and shoots. The facility with which races of plants resistant to disease may be secured by deliberate selective breeding of the natural variations has been abundantly demonstrated by the achievements of agriculturists in the production of wheats immune to rust.

This consideration of comparative immunity emphasises particularly clearly one of the apparently fundamental differences between the working of the real world and that of the dead background on which it moves. In the latter, processes and mechanisms are the dominating features. In the former, what is constant and regular is the end which is achieved, and the means and mechanism by which it is attained are seen to be variable and inconstant. The mechanisms of immunity are multiform; the uniform thing is the survival which is their end.

A convenient account of, and guide to, the literature of immunity will be found in Muir and Ritchie's *Bacteriology*.

The Famine Conditions in Western Russia and Eastern Poland

By Major W. T. Blake

Conditions in Russia are such, at the present time, that numbers of people, variously estimated at from eight to fourteen millions, are gradually but surely dying through starvation, disease, cold, and lack of housing. It was with a view to investigating these conditions that I recently flew from London to Warsaw and then made my way by rail, motor, and farm-cart through Eastern Poland and Western Russia.

The immediate cause of the present state of affairs is undoubtedly Bolshevism. When the Soviets were formed, the Bolshevists set about a thorough and systematic destruction of property; food, houses,

machinery, and agricultural implements were all broken up; even the seed corn was wasted or eaten. Last winter conditions were bad, but throughout the country small supplies of grain had escaped the general disasters and were being saved for seed in the spring. Much of this seed was eaten by hard-driven peasants, and, when it came to sowing the remainder, it was discovered that agricultural implements to till the soil were lacking. Some small acreage was roughly scratched up by crudely-made wooden tools, then the drought—which was as severe in Russia as elsewhere—arrived; the sprouting corn, barely covered by a little dust, was at once withered up, and the possibility of a scanty crop failed to materialise. Summer saw the vast majority of the population of Russia and Eastern Poland—which territory has only recently been taken from Russia—in the grip of starvation. Whilst the weather was warm many people managed to exist; with the frosts they began to die off like flies. In many parts of Russia at the present time there is no seed, no machinery, no food, no shelter, and no hope, despite the fact that excellent relief work is being carried out by several Administrations, notably the American Relief Administration and the Friends' Mission.

A GROUP OF TRENCH-DWELLING REFUGEES NEAR PORZECE.

I made my journey from London to Warsaw via Paris, Strassburg, and Prague. On reaching Warsaw I found that it was difficult to obtain petrol, and so continued my journey to Brest-Litowsk, now called Bresce-n-Bugiem, by rail. At this point one sees the first signs of trouble in Russia. Things are expensive in Warsaw, though cheaper to the foreigner on account of the rate of exchange, but there is plenty of food if one can afford to pay for it. East of Brest food is not obtainable in most cases.

At Brest is one of the Distribution Camps for refugees fleeing from Russia to Poland. In order to stop the stream of emigration the Soviet authorities have decreed that no person may leave Russia unless he has guarantees of work and financial assistance, or is already homeless. In order to qualify as homeless many thousands of people have burnt down their houses and have joined in the vast trek which is proceeding from east to west. They cross the frontier chiefly at Baranovitchi, and are then sent on to various distribution centres, among them Brest-Litowsk.

Here I saw the first starvation victims. Refugees fall out of the trains which bring them from Baranovitchi, too weak and ill to trouble much about their future. Hunger and privations have reduced them to absolute despair. Strangely enough, many of the people do not show signs of emaciation; their faces are in many cases full, and they are frequently inclined to be corpulent. This is, I understand, due to two causes: firstly, unsuitable food, if melon rind, clay, and dung can be classed as food, which causes their bodies to swell, and secondly, the fact that the Russian peasant dies long before he has reached the stage of starvation to which Indian famine victims frequently survive. The children show most signs of trouble. Small, naked youngsters crawl about the railway siding, ribs sticking out like barrel hoops, legs shrunken to skin and bone, and bellies swollen like balloons from hunger disease. Dysentery is rife and other diseases occur, though cholera and typhoid are not so common as many reports allege.

From Brest I continued to Baranovitchi, which reproduces the conditions at Brest on a much larger scale. Here is a large concentration camp where people are placed as they cross the frontier and given some slight aid before being sent on to the dispersal stations. It is a moving sight to watch the train-loads and columns of miserable wretches entering Baranovitchi. All of them are starving and in rags; many are almost naked. All of them are vermin-ridden, and groups collect scraping each other with pieces of wood, in an effort to remove the insects which swarm on

ROOFS ERECTED ON THE OLD RUSSIAN TRENCHES NEAR PORZECE.

them. Many of the children are covered with sores, while their features are hidden in masses of filth. Their eyes are encrusted with dried pus, so that they are almost blind, and flies apparently unnoticed settle on the pupils of their eyes. Sanitation is non-existent. Pits are dug in the ground and used as cess-pits. When full they are not covered in, but new ones are dug near by. Flies, during the summer, breed in these places in millions, and the stench throughout the neighbourhood is intolerable. Round the camp refugees have constructed queer shelters of boughs, reverting to the ways of their ancestors of thousands of years ago. A typical hut which I entered was built of fir boughs and measured about six feet square. In this eleven people were sleeping the sleep of exhaustion. As I entered a cloud of flies rose from the sleeping men and women, and the stench drove me outside.

There is little to prevent one from crossing the frontier into Russia. Most roads, railways, and bridges are guarded by Bolshevists and Polish troops, but there are hundreds of miles of unguarded frontier which it is possible to cross without trouble. Once over the boundary conditions become even worse. Upon the roadside one encounters many skeletons of horses and human-beings who have died on their way out of Russia, and have been left by their fellow-sufferers, who were powerless to help them. Birds and dogs finish off the flesh and the bones alone remain, marking the path of this great trek.

From Baranovitchi I made my way through various places to Porzece, where the people are endeavouring to live under almost indescribable conditions of misery. The state of affairs in this part is chiefly due to the last few years of war, for the area was fought over and shelled both by Russians and Germans, prior to the Russian collapse, and afterwards ravaged by the Bolshevists and Poles in turn during the recently-concluded war between these two nations. Three times the Poles fought over this zone, and twice the Bolshevists conquered the territory. On each occasion more of the inhabitants fled and more damage was done, until at last almost the whole population had been driven away, most of them back into Russia, and all the houses had been destroyed, cultivated land returning to a state of nature for miles on either side of Porzece. The old German and Russian trenches are populated by hundreds of refugees from the regions of Samara and Saratoff, who have made their journey right across Russia to this spot. At the time that I saw these places during the autumn the drought was still holding, and every dug-out sheltered a family of from three to twelve people. Even the trenches themselves were occupied as dwelling-places. Roofs of boughs were thrown over the top and the people burrowed in the ground like troglodytes. The dug-outs are, of course, unventilated and unlighted. In one case a family was fortunate enough to own a cow, but so great was the fear that it would be stolen that the animal was kept in the dug-out with the family,

PINSK AFTER THE FIRE.
As seen from the roof of the Cathedral.

and its heaps of manure added one more thing to the filth. These dug-outs were constructed in many cases as long ago as 1915 and 1916, and the timbers that keep up the roofs are now rotting away, so that many shelters have collapsed suddenly, burying their inhabitants beneath tons of earth.

None of the people in this district have tools to cultivate the waste land lying about them. If they could have cultivated it, they had no seed with which to sow it. This area is on low-lying ground, and though dry in the summer and autumn, with the approach of winter becomes flooded. Since my visit I learn that the trenches have filled with water and that most of the dug-outs have collapsed, burying hundreds of people under tons of mud and earth.

At Pinsk fire has added to the troubles of the people. In August a conflagration started in a baker's shop, and 414 houses were completely burnt down. All that remains standing in the heart of the town are hundreds of huge white-tiled Russian stoves built of fire-brick which withstood the heat. This gives the town the appearance of a vast untidy cemetery. Thousands of people were rendered homeless by this fire, the majority of them being Jews.

The country between Pinsk, Kief, and Zhitomir is supposed to be one of the regions which has suffered least, but it is impossible to compare the state of one part of Russia with that of any other part. Samara and Saratoff are generally called the worst districts. Millions of people have left these zones for other parts which they found nearly as bad. The constant moving of people from east to west is not improving matters, but merely evening up the desolation of the whole country. At Saratoff bread costs about 25,000 roubles per pud (40 lb.), a figure which not one man in a million in Russia can afford to pay. I may mention that it is impossible to get a fixed quotation for the rate of exchange, but my average for the English pound was about 240,000 roubles. Wages might almost be said to be non-existent. People live on filth or starve. Only the Bolshevist army and officials are decently fed.

The problem of solving the Russian question is great. Even if food could be brought in from outside sources at once, it could only alleviate the trouble to some slight degree. In addition to food, clothing, farm implements, and large quantities of seed are needed at once, and, when one thinks of the area of this huge starving country, one realises that to carry out any adequate relief scheme is a practical impossibility. When Bolshevist authority is taken in conjunction with the natural difficulties of the region, it would appear useless to attempt any form of relief. Russia's only solution of the problem lies in herself. Many millions of people have died of starvation and disease, and many millions more are dying of cold this winter. They cannot be saved. It is inevitable that about ten millions must die and years of hardship face the survivors. The Russian peasant's own idea is to get out of Russia into Poland. The peasant distrusts the Soviets, and would rather be under Polish dominion. Here another difficulty is encountered, for Eastern Poland is in almost exactly the same condition as Russia, with the exception that relief destined for that country does reach the people concerned.

I have already stated that during the war this country was fought over several times. At the conclusion of peace between Poland and Russia, the Polish frontier was moved east from Brest-Litowsk to a line approximately Vilna–Baranovitchi–Pinsk. Labour conditions in Russia are intolerable. In Eastern Poland conditions are very similar; for example, the following list of salaries is representative of the country (at rate of 9,500 marks per £1):

Bank clerk, 12,000 marks per month = 25*s.* approximately.

School teacher (female), 5,000 marks per month = 10*s.* 6*d.*

Miner, 9,000–18,000 marks per month, plus a certain amount of food (10*s.*) =38*s.*

Farm labourer, never over 6,000 marks per month = 12*s.* 6*d.*

Minister of the Government, 70,000 marks per month = £7. 7*s.* 6*d.*

Private of the Army, 28 marks per day, plus rations, or 75 marks per day and no rations = ¾*d.* or 3*d.*

Second Lieutenant, 12,000 marks per month, of which 2,000 marks are paid for rations = 25*s.* (4*s.* 2*d.* for rations).

The average wages earned in Poland in the spring of the year were about 8,000–12,000 marks per month (i.e. about 17*s.* to 25*s.*).

In comparison with the low scale of wages paid, food prices in Poland are abnormally high, the following figures being those at present obtaining in most parts of the country:

White bread . . 80 marks per lb. (2*d.*)

Rye bread . . 30 marks per lb. (¾*d.*)

Potatoes . . 12 marks per lb. (just over ¼*d.*)

Oats and barley, 12,000 marks per pud (40 lb.), 2*s.* 6¼*d.*

Meat, beef, mutton, or pork, 82 marks per lb. (2*d.*)

It is difficult, indeed, to understand how the great majority of the people live.

In Russia prices may be taken as being in approximately the same ratio to wages, but whereas in Poland the exchange is under 10,000 marks to the pound,[1]

[1] The rate has varied considerably since my visit.

in Russia one receives about 240,000 roubles to the pound.

After my experience of the terrible scenes which I have described, and others, more terrible, which are beyond description, I returned by various methods to Pinsk, whence I took train to Warsaw. On this line one train a day runs in each direction, the journey of approximately 300 miles taking twenty hours. This is due partly to the fact that the railway stock is in a very poor condition, and partly to the fact that the track is so bad that high speed would be dangerous. The chief cause of the length of the journey, however, is the fact that the train invariably stops for periods of from half an hour to two hours at intermediate stations. The reason for this I was unable to ascertain. All the information I could gather was that there was no hurry, and that to-morrow would do as well as to-day.

During the days I was in Warsaw, the rate of exchange was as bad as 12,730 marks to the English pound. It afterwards fell to 20,000, and then rose again to about 12,000. To the Pole 10,000 marks represent £500 in pre-war figures, and though, of course, it has not that value at the present time, it is nevertheless a very large sum.

Altogether, though prices are high according to the Polish idea, Warsaw itself wears an air of something akin to prosperity, though the condition of the roads is appalling.

Wireless Navigation and Nocturnal Flight

A French scientist's solution of the problem of aerial nocturnal flight and the guidance of vessels into port by means of a Cable-guide and Wireless

By George Frederic Lees

THE problem of aerial flight by night or in foggy weather—one of the most difficult problems with which aviation experts have been faced—is now within sight of solution, thanks to a development of wireless telegraphy imagined and applied, first of all in the case of ships at sea and afterwards in the case of aeroplanes, by a young French scientist, Monsieur W. A. Loth, who until recently was a student, under the late Monsieur Boutroux, at the Fondation Thiers, Paris. The Academy of Sciences has already recognised the value of M. Loth's maritime work by bestowing upon him its "Prix de Navigation." Recently a practical demonstration of the great utility of the invention was given by M. Loth on the aviation ground of the Nieuport Company at Villacoublay, near Paris, and many experts who gathered there considered the experiments very striking.

Since this new departure in aeronautic science is based on M. Loth's first invention, that of the cable-guide for ships entering difficult harbours, it will be well if I begin with a short account of this electrical discovery, which is already being exploited commercially. For the harbours of Brest and Le Havre are about to be supplied with cable-guides; a project is on foot to lay one of these cables between another French port and one of the south coast ports of England; whilst applications for similar installations are coming from maritime authorities in many parts of the world, notably Belgium and South America.

In considering the means by which a vessel navigates into port at night-time, M. Loth soon came to the conclusion that visual signals are useless in foggy weather, that sounds, such as foghorns which are used in practice, are uncertain, and that plotting one's position from wireless signals affords a series of approximate points only. In brief, the navigator is at the mercy of many errors. But, if the entrance to a given port were supplied with a submerged cable and the navigator could be furnished with a means of following it, it is evident that the problem might be solved. So the inventor set to work to find a way of locating such an invisible cable. After experiments had been made on a small scale on the Seine with a motor-launch and a cable lying on the bed of the river, M. Loth transferred his operations, under the auspices of the French Admiralty, to Brest, where a properly insulated and protected cable was laid. On land, in the port, he placed a source of electric current, an alternator, and connected one pole of the generator to the copper core of the cable, the other to a plate immersed in the sea. Now, during an alternation an electric current flowed through the cable, and the end of the cable being bare the current returned through the sea to the copper plate connected with the other pole of the alternator. In the next alternation a similar circuit was traversed in the reverse direction. Such was the principle. All that remained to be done was to locate the current flowing through the cable, and this, M. Loth found, could be done in several ways. The method finally adopted will now be described.

Four receiving spirals are installed on board the vessel. These spirals are constructed of a number of turns of wire wound on wooden frames forming boxes, the frames being strongly built and well insulated.

Two are large (with sixty turns), one being arranged transversely, the other longitudinally with respect to the ship; two are small (ten turns), one placed trans-

versely, the other longitudinally. The wires leading from these frames end on a switch-board containing all the electrical equipment. Each is connected to a telephone, and observations are made by listening in. The ship is manœuvred to enter a harbour safely as follows: The ship is first steered approximately by soundings. It being known that the guiding cable lies, say, in a direction from east to west, a course north-west must be set to pass over it. The navigator naturally does not know at what point he will pass over the cable, but pass over it he must. An observer is placed at the switch-board and listens in on the transverse frame with sixty turns. At a given moment he receives a signal. The ship is then so set as to receive a maximum of waves from the cable on the transverse

FIG. 1.—HORIZONTAL OSCILLATING FRAME.
This enables an observer to study the aerial field above the earth, and to determine the direction of the source emitting the electric waves.

and a minimum on the longitudinal frame, indicating that the course is at right angles to, and of course approaching, the cable. The intensity of reception increases as the cable is approached. From time to time the observer listens in on the spiral of ten turns of the transverse frame, but hears nothing until the ship is sufficiently near. At the moment of making contact on this coil the vessel is turned through 90°, for this signal indicates that it is about 300 metres from the cable. The ship is then set so that there is a good signal on the small longitudinal frame and zero signal on the transverse. In this case a course is being held rigorously parallel to the cable and at a distance less than 300 metres from it. Even if there is a strong cross-current, it is possible to maintain on the longitudinal frame a signal of constant intensity. Vessels keeping to the right—i.e. having always the cable on their left—know its direction and consequently their own course. At any time they can find out whether they are approaching or receding from the cable and know where they are relatively to it. Thus the dangers of fouling, of grounding, or of striking a rock disappear completely, and make navigation practicable. It was found possible, for example, to steer a 400-ton gunboat, *La Belliqueuse*, along a cable placed at the mouth of the entrance to the Brest harbour under conditions of perfect safety. *La Gloire*, a 10,000-ton cruiser, was also piloted along the same cable.

The current flowing through the submerged cable is only 2·5 amperes. Yet it can be detected, even without adjustment to resonance, as far away as two to three kilometres, so that the total listening zone is four to six kilometres.

It may be added that these experiments, witnessed by the Minister of Marine, were first conceived in the laboratory in 1914, but not carried out until little more than eighteen months ago with the help and co-operation of the Dredging Commission of the French Admiralty. The method, based on a number of patents, was not announced until much later, not, in fact, until the inventor was fully satisfied with its efficiency.

Shortly afterwards M. Loth discovered that in the case of aviation at sea the total listening zone in the air above the submerged cable was three kilometres. It was this which suggested his second discovery, which arose from a further series of experiments on the problem of guiding the nocturnal flight of aeroplanes and airships.

On the Villacoublay aviation ground is an old interred cable, formerly used for carrying an electric current, which zigzags no fewer than eight times and underlies much of the area of the ground. By means of this cable, after it had been put into a state of repair, M. Loth experimented with his receiving apparatus, installed first on Farman aeroplanes and afterwards on Nieuport machines, placed at his disposal by M. Léon Bazaine and the Nieuport Aeroplane Company. The inventor began by making a complete study of the magnetic field set up when an alternating current with a frequency of 600 per second was passed through the cable. This field was explored at great distances from the cable (at one time a distance of several kilometres, with the receiving apparatus on a motor-car), and often yard by yard. M. Loth also studied the exact form of the magnetic fields of the magnetos on his aeroplanes, which at first sight would appear to complicate the problem.

This difficulty, however, was overcome, and the noises from the magnetos were almost entirely suppressed, and did not interfere with the reception of the waves

from the cable. He eliminated those noises by means of a small receiving frame placed near the magnetos. This small frame was so wound that, when it was placed in series with the more distant receiving frame, the currents induced in these two frames by the variable magnetic fields of the magnetos were annulled.

The receiving frames are placed on the aeroplane much as they would be on the ship, and, to perfect reception through the telephones, the tuning, as in the case of the apparatus on board ships at sea, can be rendered sharper by mounting the apparatus on a resonator. When the aeroplane or airship has its

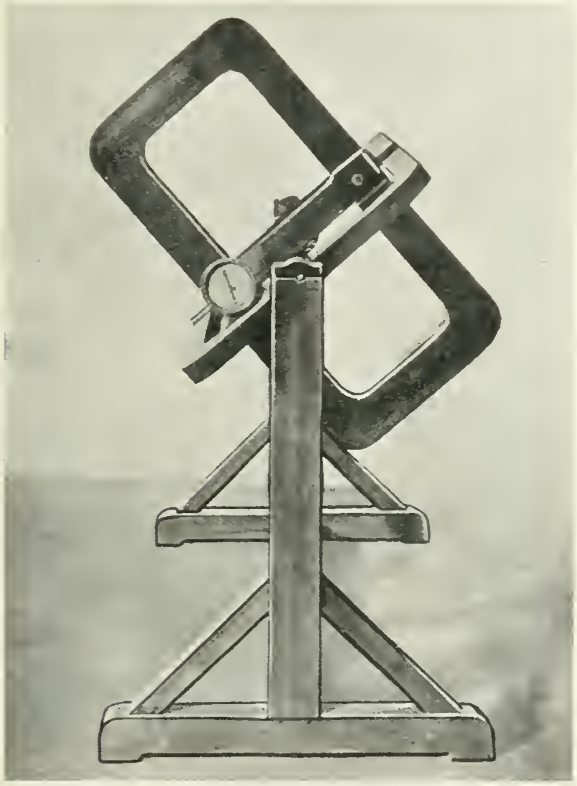


FIG. 2.—VERTICAL OSCILLATING FRAME COMBINED WITH HORIZONTAL FRAME.

This suspension, with a universal joint, enables an observer to determine the position, as regards direction, of the source from which the electric waves emanate.

axis parallel to the guiding-cable the longitudinal frame receives the maximum of waves, and the transverse the minimum. The opposite is true when the aeroplane is moving at right angles to the cable, that is to say, the longitudinal frame receives less and less as the aeroplane inclines towards the guiding-cable and none at all when the machine becomes perpendicular to it, and the transverse receives more and more as the axis of the aeroplane tends to be at right angles to the guiding-cable and a maximum when it is travelling perpendicularly to it.

The longitudinal and transversal frames may be replaced by two vertical frames placed at 45° to the axis of the fuselage of the aeroplane. The horizontal frame receives when the aeroplane is influenced by the variable magnetic field of the guiding-cable, that is to say, when it is either near, or at a certain distance from, the cable, but reception is annulled with great clearness when the aeroplane passes right over the line. Inclination towards the left or right is obtained by placing the longitudinal and transversal frames in series successively and in two opposite ways. Instead of using the lateral frames, simply or in series, one can, when wishing to know when one is passing from the left to the right or from the right to the left of the cable, place the longitudinal and horizontal frames in series successively and in two opposite ways. Landing at aerodromes is effected by placing the transversal and horizontal frames in series in two successive and opposite ways. This same placing in series will indicate when the machine is flying horizontally, the ascending of the cable on the side of a mountain or its descent into a valley. And thus an aeroplane or a dirigible can rise or descend, following the same angle, without the necessity of visibility.

Some results obtained by M. Loth may now be given. With the horizontal frame there was contact at a height of about three kilometres. Contact with the vertical frames took place at an altitude of two and a half kilometres. At a height of two kilometres one could hear on the whole of the receiving apparatus, and it was possible to guide the aeroplane without being troubled either by the noise on board or by the magnetos. At a height of one and a half kilometres reception of the waves was perfectly clear and even fairly loud. At an altitude of one kilometre it was loud. At 600 metres one could hear quite well even when the receivers were removed from the ears. At an altitude of two kilometres contact was obtained when over ground which was two kilometres distant from the cable; at a kilometre and a half the zone to which the waves from the guiding-cable extended was much greater; whilst at a kilometre the range was several kilometres. On the earth the range attained fifteen kilometres.

It must be remembered that these are *minimum* results obtained with a chance cable of barely three kilometres in length and one making no fewer than eight turns. The longest straight portion is only half a kilometre. There can be no doubt that the results would be more striking if a normal cable of great length and without sharp twists were used. The intensity of the current in the cable varied from 4·2 to 2·8 amperes.

In practice it is suggested that aeroplanes following the cable in one direction would fly at from 900 to 1,000 metres altitude, with freedom to manœuvre either to the right or the left, whilst those flying in

the opposite direction would fly at an altitude of not less than 1,100 metres, with the same liberty in manœuvring. For landing each aerodrome would be supplied with cables arranged like the radii of a circle formed by a cable surrounding the aerodrome; this would enable the aeroplanes to alight facing the wind always.

Ancient Warfare in India

By Sirdar Ikbal Ali Shah, F.R.G.S.

THE art of war was quite as closely studied in ancient India as it is in the highest military circles to-day. The moral codes of the sacred books called the *Çāstras*[1] led to the varying principles of warfare. In one of these we are told that war is a necessary evil, the sole alternative to be adopted upon the breakdown of diplomacy. The life of the warrior was regarded in old India as one which was highly pleasing to the gods. "A hero," says the author of *Agnipuran*, "enjoys the pleasure of life by victory, or conquers heaven by death. A soldier cannot better requite the debts of his sovereign than by sacrificing his life in battle for his sake. A soldier cannot wish for a happier end than death in battle. Death in battle is the happiest of all austerities and of all sin-expiating penances prescribed for a soldier. The soldier who deserts his comrades or who flies from the battle-field incurs the sin of killing a Brahman, and the gods forsake such a vile coward. The soldier who prefers death to defeat and thinks it more honourable to die in the front acquires a merit of a thousand horse sacrifices."

The early hymns of the *Rig-Veda*,[2] one of the four holy books of the Hindus, those strange relics of the infancy of the Aryan races, contain prayers to Indra, the god of firmament and of rain, for success over the enemy, "the dense, devilish heathen hordes of the aborigines of India." The rewards of a good woman by the gods was a warrior son, a sword-hero who would rejoice her heart. It was not until the differentiation into castes of the Indian races, which occurred soon after the Aryan settlement, that the profession of arms became the preserve of a special section of society, a developed chivalry, the *Kshatriya*.[3] The old books, notably the *Sukraniti* and *Kamandikiya*, which are amongst the works of great celebrity, speak of Brahman generals and commanders who won glorious victories, so that it was not regarded as improper for a devotee of that exalted cult to be also a soldier.

This notwithstanding, the *Smitris*, sacred writings of equally good repute, discouraged recourse to arms except as a last expedient. The waging of war for the acquisition of territory was regarded as wrongful, and a victory gained in battle was thought inferior to a diplomatic triumph. On the other hand, the *Artha-çāstras*, or the books that preach profit rather than virtue, were consistent advocates of the prosecution of warfare for the purpose of gain. Only let a monarch be strong enough and sure enough of success, and then, they advocated, he was foolish if he did not make an effort to attack the possessions of his neighbours. A foe must not be allowed to exist in a state of contentment, but must constantly be harassed until thoroughly beaten and broken. To trust a foe who was not completely crushed was to trust a cobra half-beaten. But he who was beneath the yoke of another should strive constantly to throw it off by every means in his power.

The necessity for large sums of money to carry on a successful campaign was touched upon in the ancient writings. A hymn in the *Rig-Veda* asked the god Indra to bestow sufficient wealth to maintain a large army. During war a king might requisition money and public property from his subjects, and it was the duty of a loyal subject not to object to such a proceeding.

One of the chief duties of a king was to spend con-

[1] The *Çāstras*, sacred books of the Hindus, were probably written during the second to third centuries B.C.; and the information in this article is mainly collected from two sets of these writings, the *Dharmaçāstras* and the *Arthaçāstras*. The former are very early metrical law-books, written in classical Sanskrit, and probably based on lost *Çāstra* collections of the Vedic School. They include the writings of *Manu*, *Smitris*, and *Rajdharma*, all of which advocate high ethical standards of life and conduct. The latter set, which were also written in Sanskrit, embrace amongst others the writings of *Bharta*, *Sukraniti*, the work of Sukracharya, a great Hindu sage and philosopher of the second century B.C., and the *Kamandikiya*, the work of the celebrated Kamandiki, a religious writer of the same age as Sukracharya; and lastly *Agnipuran*, one of the most ancient religious treatises of the Hindus, dating from about the fifth or sixth century B.C. These works advocate more practical, and far less idealistic methods of life and conduct.

[2] The *Rig-Veda*, a work in Sanskrit language, is a folk-song and a remarkable literary remnant of the early Aryan settlements in the Punjab. Many Hindus believe that it dates from the fourth century B.C. at the latest. European scholars have computed from astronomical dates that part of its composition was going on about 1400 B.C. The *Rig-Veda* is not a *Çāstra*.

[3] There are four chief castes amongst the Hindus: the Brahman, the priestly class; the Kshatriyas, the military class; the Vaish, tradesmen and petty individuals of society; the Shudras, the menial class.

siderable sums upon the building of forts in strong strategic positions. These were to be places of refuge for his people in time of war and bases for military operations. Fortified places were to have their quota of all castes, but especially of the commercial and servile classes, in order that these might enhance the value of the surrounding country. "An archer within a fort," wrote Sukracharya, "is worth a hundred outside the walls." A fort which was not strongly equipped and well supplied became a source of danger rather than protection.

Two kinds of fortification were specified, natural and artificial; the former, those afforded by the configuration of the country, the latter, erections of obstacles. In the early writings of Manu, Bharta, etc., natural fortifications only were considered; the later books, such as *Sukraniti* and *Agnipuran*, treat of both. Six kinds of natural fortifications were alluded to in the later books: plains or deserts surrounding the royal city or fort, in which invaders would be unable to find sufficient sustenance for their men; plains full of pits and holes, impassable by cavalry or cars; marshes; watery tracts; bushes; forests. A district surrounded by strong allies was also regarded as a useful fortification, and if mountains had to take the place of friends, so much the better, as they could not prove treacherous. The country in which a king proposed to reside and surround himself with defences should have plenty of food-stuff, and its water-supply should not depend upon the rainfall alone. "Forts," says a hymn in *Agnipuran*, "must be built on hills or in forests or in deserts or vast plains." Detailed instructions as to the manner of their erection are to be found in *Sukraniti*. "Forts," says this book, "are to be surrounded by a moat filled with water, in which crocodiles and sharks shall swim, and their towers must be well equipped with weapons."

Sukracharya laid down the qualities and the strength of an army. It consisted, according to his book, first of the *Mula*, or fully trained and veteran troops, and the *Sadyaska*, or recruits. The latter were divided into "heroic" and "unheroic," the first category being further subdivided into trained and untrained, and the second category into "those that deserted from the enemy" and "those weaned over from the enemy." *Kamandikiya* enumerated the order of troops for battle as follows: the *Mula*, the mercenaries, the volunteers, the allies, those who had deserted from the enemy, and the "forest tribes." The responsible positions and most arduous fighting were allotted to the *Mula*, who played much the same rôle as that of the German *sturmtruppen* and the Italian *arditi* in the late war.

The four branches, or units, of the military service were clearly defined. These were cavalry, infantry, car-warriors, and elephant-men. There were also reserves and munition-carriers, whose duty it was to carry weapons and stores to the fighting-line, as also to remove the wounded from the front to the base hospitals. The proportion in which the several units stood towards one another was curious, as it was calculated on what is known as *Patthi* system. Ten being recognised as a convenient number, the proportions of the numbers of each fighting arm were based thereon. *Patthi* signifies the formula of 1 : 1 : 3 : 5, and, to explain it further, it stands for one elephant, one car, three horsemen, and five foot-soldiers. The unit of calculation was 21,870. Thus in a satisfactory army there were as many as 21,870 elephants, 21,870 cars, 65,610 horsemen, and 109,350 infantry. Elephants and guns were regarded as of equal value. "One elephant, duly trained in the way of warfare and ridden by a skilful hero," was considered capable of slaying six thousand horses (in *Kamandikiya*, xv).

But all these four units were, as a rule, not employed in one and the same campaign, the nature of the country, as well as the season of the year, dictating those which should be used. In rough country infantry was considered much more useful than any other unit, and elephants could not be taken through country where there was little water, or the trees of the type which would serve for their food were scarce. Chariots and cavalry could only be employed in hot or cold weather, while in the rainy season only the elephants could be used.

The duties of the various units were in elaborate detail. Infantry were employed to clear paths and roads, guard the lines of communication, procure water for the army, and remove wounded to a place of safety. Chief amongst the infantry were the swordsmen, whose duty it was to defend the main body of the army against any attacks directed against it. Archers were included among foot-soldiers, and engaged the enemy at long ranges. Charioteers harassed the rear of the enemy's forces and carried the wounded off the field. Cavalry was used to guard and supervise transport and commissariat, cover the rear of a retreating army, carry despatches and pursue a beaten enemy. The elephant corps carried out the duties allotted to the modern tanks, being chiefly used for breaking down the first line of the enemy's forces, for shattering the formation of battalions or phalanxes, and even for demolishing walls and towers. It headed the army on the march, acting as a pioneer body, and reconnoitred forests, while under its sheltering screen broken columns or regiments re-formed.

Weapons were divided into two classes: *Astra*, or missiles; and *Sastra*, hand weapons with a cutting edge. To the former variety of arms a supernatural origin was accorded, so that the bows and firearms were called "magical bolts." Firearms were divided

into muskets and artillery, the latter carried on the backs of draught animals. It is strange to find cannon and gunpowder alluded to in these venerable books, and this upholds the theory that such weapons of precision were originally invented in the East. Gunpowder, so they instructed, was to be prepared from five parts of nitre and one part each of sulphur and charcoal. Cannon was principally used for bombardment of fortified positions, and for demoralising rather than killing the enemy. Bows and arrows were evidently not regarded with that respect which they gained in ancient England, and which made the English archer's name so terrible in France and Scotland. On the other hand, the sword was greatly depended upon as a weapon useful for close combat and capable of being wielded more skilfully than the battle-axe, and swordsmen, it was advised, should be let loose on the enemy towards the conclusion of the battle, to decide the issues of the day. Metal armour was recommended for the protection of troops, and leather armour for the protection of horses and elephants.

The *Arthaçāstras* urged that, once war had been decided on, measures should be taken to arouse rebellion in the enemy's territory, and that his officers should be bribed and "vain promises" made to them. His supplies should be exhausted by every means, and he should be worn down by chicanery and treachery. The army should not rely on supplies on the route to the enemy's country, but should carry a sufficiently large amount of provisions on specially selected pack animals. Nor should skilful physicians and an adequate supply of drugs and medicines be forgotten. The *Dharmaçāstras* instructed that fitting respect and sacrifice should be paid to the guardian deities of the region through which the invading army passed, nor should the population of the country be in any way molested. Villages on the high-roads might, however, be destroyed by defending forces, lest they afforded shelter and supplies to the enemy, and all stores of grain gathered to a safe place. Defending forces were also admonished to destroy bridges, keep a vigilant guard over mountain passes, and poison the wells in outlying districts.

An army on the march was disposed as follows: The king, with the treasury and women, was placed in the middle of the forces; the flanks of the army were guarded by cavalry and chariots, with elephants and scouts on the extreme outside. In actual battle the forces were arranged in such a manner that they might readily assist one another. Thus a horseman was placed at an interval of every third foot-soldier, and an elephant or chariot at an interval of every five. Four infantrymen guarded each elephant, four horsemen a chariot, four swordsmen defended a horseman, and four archers a shield-bearer. The van consisted of the flower of the army, but the importance of the rear-guard was never neglected. The swordsmen occupied the most advanced positions, and after them came the archers, cavalry, chariots, and elephants in the order named. The general took up a position beside the standard or nucleus of the army, the king remaining in the rear, whence he could encourage his men, and rally round him any broken division. But he was not expected to venture into the fighting-line, as his death meant annihilation and defeat for his whole army. The longer the front the better, since only by the aid of an extended front could successful flanking movements be made.

Agnipuran gives an interesting account of the various *Vyuhas*, or battle-formations. An army drawn up in a *Vyuha* was divided into five parts: two wings, two sides to protect the wings, and the main body including the nucleus. Of these not more than two divisions might be brought into action at one and the same time. The disposition of the *Vyuha* was based upon the principle of arranging the different arms in such a manner as to form the best possible defence consistent with the position in which the army found itself, and according as to whether danger was anticipated on the front, the wings, or on all sides.

For strictly defensive warfare the leading of small guerrilla parties against the enemy's weak points was recommended. The plan of attack against an army of equal forces consisted of an attempt, either to envelop its flanks, or to cut its forces into two by driving a wedge through its centre. Ruse and ambush were also part of the tactical scheme of attack. Methods of fighting were, indeed, divided into two kinds, *Dharmayuddha*, or fair fighting, and *Kuttayuddha*, or unfair fighting. In the former unfair weapons, or weapons such as would inflict unnecessary pain, pursuit of the wounded or beaten, attack on the unprotected, neutrals, or an enemy in the act of surrendering, or camp-followers, were not permitted. The priest, and the artist too, were to be protected in the event of a city being taken by the conqueror, and had to be held in all honour; the families of the slain soldiers who belonged to the enemy's forces had to be pensioned; and the customs of a defeated people recognised and maintained. The methods of *Kuttayuddha* were much less frequently resorted to.

These are not the sentiments of barbarians, but of an advanced and enlightened society, in which war was regarded as a necessary evil rather than as an essential to existence. That the whole art of warfare was carefully studied is plain from what has gone before. Serious thought was manifestly lavished even upon the smallest detail, and it is evident that in India during the period 1400–800 B.C. the military art was as closely attended to as it was later at Rome or Athens.

Reviews of Books

SOME BOOKS ON PHYSICS

(*a*) *What is Science?* By NORMAN CAMPBELL, Sc.D. (Methuen, 5*s.*)

(*b*) *Atomic Theories.* By F. H. LORING. (Methuen, 12*s.* 6*d.*)

(*c*) *Fifty Years of Electricity.* By J. A. Fleming, D.Sc., F.R.S. (The Wireless Press, 30*s.*)

(*a*) Dr. Norman Campbell has written this book with the hope of encouraging the study of science in the classes of the Workers' Educational Association. His object has been to explain what are the aims and objects of science, and what kind of satisfaction can be derived from its study. He has aimed at drawing attention to those aspects of its more abstruse departments which may be expected to appeal to men and women of wide intellectual sympathies. The chapter headings are: Two Aspects of Science; Science and Nature; The Laws of Science; The Discovery of Laws; The Explanation of Laws; Measurement; Numerical Laws and the use of Mathematics in Science; and The Applications of Science. These should give a reader an idea of the contents.

This is a valuable book, and much of the value lies in the exposition, which is simple, scientific, and eminently sane. Dr. Campbell has written a book which makes a subject, by no means a simple one, not only intelligible, but really interesting and even fascinating, and this he has done in simple English without employing mathematics or technical expressions. Few books have come to my notice which can be recommended to the reader more whole-heartedly than this one.

(*b*) The greater part of Mr. Loring's book deals with subjects too specialised in character to be followed except in outline by readers of this journal, but as it is the first book to deal comprehensively with the newer subjects which are now engaging the attention of many of the present generation of scientists, it would not be right to pass it over in silence.

The author has gathered together in book form the main facts and theories of the recent work on the atom associated with the names of Aston, Bohr, Bragg, Langmuir, Planck, Rutherford, and J. J. Thomson. But it is a curious book. Many will find it a mine of information, but the illumination in the mine is curiously uneven, and it is essential that one should watch one's step. The book suffers because the author has written necessarily from the point of view of a special reporter who tries to set down faithfully what he has heard or been told, instead of from that of one who is inside the subject, and who can really write about it critically.

The subject at present is too unsettled to be described in a book; moreover, it is too difficult for all but those who have taken their degree. Why, then, not wait for more tranquil times, and leave the research man to do until then what he is easily capable of doing, namely, to hunt up the necessary information in the original papers themselves?

The first four chapters deal with the atom, the nucleus, atomic weights, and isotopes; Chapter V with X-ray spectra; and Chapters VI and VII with radio-activity and crystal structure as clues to atomic structure. In Chapters VIII and IX are given accounts of Rutherford's atom and the quantum theory; and these lead logically to Chapter X, which discusses the Rutherford-Bohr atom. Six of the later chapters deal with the recent Lewis-Langmuir atomic theory, which was discussed at the British Association at Edinburgh. The book finishes up with accounts of atomic and solar energy, the magnetic properties of the elements, and a series of appendices.

The author has covered an enormous field, and has really shown great energy and enthusiasm, but many paragraphs appear as though they were the first draft and badly require rewriting. The arrangement of chapters is very poor, being in places "all anyhow." The author, too, has a fondness for interpolating oddments of information that are irrelevant and unnecessary. One of the appendices, for example, explains the meaning of negative indices. Surely a reader who is capable of understanding the Rutherford-Bohr atom, or of following the many explanations which Langmuir's theory involves, need hardly be told or even reminded that 10^{-3} is the same as ·001!

(*c*) The Wireless Press are to be congratulated on publishing this large and handsome book on Applied Electricity by Professor J. A. Fleming. Its sub-title, the Memories of an Electrical Engineer, suggests a biographical treatment, but the book is neither treatise nor biography, but one of those comprehensive accounts of a subject, written for the intelligent general reader, which a reviewer is delighted to welcome from an author competent both in knowledge and in exposition.

This book places before the reader a popular but careful and comprehensive view of the chief triumphs of applied electricity during the last half-century. This "fifty years of Europe" is the period of Dr. Fleming's service in electricity. One chapter deals with the great improvements made in telegraphing and telephoning in the five decades, another with electric lighting, a third with electric cooking, heating, and furnaces, a fourth with power transmission, a fifth with wireless telegraphy and telephony, and so on for all the principal divisions of applied electricity. Even the theory is not overlooked, and an interesting chapter on the great strides made in that department of physics is included.

A. S. R.

Prehistory: A Study of Early Cultures in Europe and the Mediterranean Basin. By M. C. BURKITT, M.A., F.G.S., with a short Preface by L'ABBÉ BREUIL, Professor at the Institute of Human Palæontology, Paris. (Cambridge University Press, 35*s.*)

Mr. Burkitt has attempted to supply a need which every student of prehistoric archæology has long felt. It is a remarkable fact that there should still be no modern book in the English language dealing with prehistoric archæology as a whole and written by one who has himself conducted researches in each department of it. Good and indis-

pensable as it is, and as it always will be, Dr. Rice-Holmes' *Ancient Britain* is the nearest approach to the ideal; but it lacks, at any rate in its earlier chapters, the vision and mastery that come only from field work. Mr. Burkitt's title covers the whole of prehistoric time, from the dawn right down to the end of the Bronze Age. But the author is obviously most interested in the later portion of the palæolithic period, and the chapters on Cave Art are by far the best.

The general arrangement of the chapters is admirable. The author has the French love of classification, particularly in relation to chronology. Opposite the first page is a table of archæological divisions, showing their relation to the glacial periods. We do not agree with all Mr. Burkitt's equations, and we think he should have made it clear that they are still matters of controversy rather than universally accepted conclusions. But every reader will thank him for having the courage to record his own opinions in this irrevocable manner.

The first four chapters clear the ground for the rest. The first ("Introduction") concludes with a tabular "Brief Outline of the History of the Subject" from 1690, when a drift-implement[1] was found near Gray's Inn, to 1915, when the Abbé Breuil "studied the painted rock shelters at Almaden in the Spanish second style." Presumably Mr. Burkitt did not intend to do more than indicate a few landmarks in palæolithic research; but even so he cannot be excused for certain very serious omissions. One of these landmarks was the publication of *Ancient Stone Implements* by Sir John Evans; another was the investigation of the Mousterian deposits at Northfleet by Mr. Reginald Smith, F.S.A., of the British Museum; a third was the foundation in 1908 of the Prehistoric Society of East Anglia, which is now, in the opinion of some, the liveliest and most important archæological society in England.

Chapter III, "Man in Relation to Geology," contains a very useful summary of the French and British evidence upon which any attempt at correlating palæolithic and glacial periods must be based, but as it involves theories and facts of a highly technical kind, it is not discussed here.

Mr. Burkitt refers on p. 59 to Baron de Geer's methods of dating the retreat of the ice-sheet in Scandinavia by counting each of the layers of sediment deposited during the summer thaw. "By this means their total number can be obtained, which gives us the period taken by the ice to retreat from South Scandinavia to the north. The number is about 5,000, and therefore the retreat took about 5,000 years. Fortunately, these layers continued to be deposited up in the north, in Lake Ragunda, from the moment that it was uncovered by the retreating ice. This lake was drained about the middle of the last century, and the number of layers there was about 7,000. The number of years, therefore, from our own day to the time when the ice was in South Scandinavia is 7,000 + 5,000 = 12,000 years." We quote this paragraph for the information of those who imagine that Baron de Geer's chronology was not "hitched on" to the present; though the title to one of his papers—"A Geochronology of the *Last* 12,000 Years"—should have made his position quite clear; and his results were provisionally accepted by a distinguished English geologist so long ago as 1911 (Sollas, *Ancient Hunters*, 1911, p. 397).

When we come to the close of the palæolithic period—the so-called Upper Palæolithic or Cave Period—we begin to become involved in such a maze of racial movements that we almost despair of reaching any certain conclusions. Broadly speaking, however, there seem to have been two main but intermittent streams of migration—from Africa northwards and from Eastern Europe and probably from Central and Northern Asia westwards. If this was so—and at certain periods it certainly was—we may recognise the earliest of these long familiar prehistoric migrations that were repeated in later times, as, for instance, in the invasion of Britain by the beaker-folk[2] and in the conquest of Spain by the Arabs.

We do not think Mr. Burkitt has improved upon Dr. Osborn's account of the late Palæolithic migrations, based largely upon the same documentary evidence as Mr. Burkitt has used. Tangled as the problem they present undoubtedly is, we think there is a valuable clue to its ultimate solution in the climatic changes which were taking place. The improvement of the climate which took place as the glaciers receded is naturally most familiar to us in North-west Europe, where it created a habitable country for man. But what was happening in the Sahara and in the heart of Asia? Surely the reverse. During the last great glacial period (say, 30,000 to 18,000 B.C.) the Sahara must have been a habitable—perhaps even a very desirable—region, fulfilling all the needs of Man the Hunter; and its gradual desiccation must have meant a steady emigration northwards and southwards. According to Mr. Brooks,[3] "in the Lower Nile Valley the deposition of gravel ceased, and that of mud began, about 8,000 B.C., indicating that at that time the climate of North-east Africa reached its present state of dryness." In other words, the Sahara—at any rate, the Eastern Sahara—was formed between 18,000 and 8,000 B.C. Such archæological evidence as we have fully bears out this hypothesis. Perhaps it was a later wave of the northward migration of Late Palæolithic times which brought the Mediterranean Race into these islands, and which scattered megalithic monuments along the whole Atlantic seaboard. It is, at any rate, very remarkable that we meet so early with the same puzzling contradictions as we find at the end of the Neolithic Age. It is difficult to account for the sporadic roundheads[4] of the Upper Capsian period in the Tagus Valley and for the stray beakers found much later in South-east Spain and Sicily; but it is reasonable to suppose that not dissimilar causes have been at work to

[1] An implement of the type associated with the River Drift gravels.

[2] The beaker-folk, or round-headed people, who introduced the distinctive ceramic type known as the beaker into this country buring the Bronze Age.

[3] "The Evolution of Climate in North-west Europe," by C. E. P. Brooks, M.Sc., F.R.Met.Soc., F.G.S., *Quarterly Journal of the Royal Meteorological Society*, vol. xlvii (July 1911), No. 199.

[4] Occurrence of skulls of roundhead type.

produce such similar results. For the beaker-folk and roundhead type are both admittedly Central European types; and at both periods the two occur as exceptional features in cultures with mainly southern affinities.

The chief difficulty in tracing migrations by means of industrial types—always a dangerous proceeding when not checked at every point by anatomical evidence—lies in the difficulty of selecting the "key industries." This is peculiarly difficult when dealing with the "Azilian-Tardenoisean microlithic" industry, which ranges from South Africa to Scandinavia and from Cornwall to India. Only by a close study of selected unmixed type-stations can results of any ethnological value be obtained. The time is not yet ripe for generalities.

Mr. Burkitt is seen at his best in his chapters on Art, though he is apt to wander off into too many fascinating side-issues. O. G. S. C.

[Since the above was written Prof. R. A. S. Macalister has published the first volume of his *Textbook of Archæology* (Cambridge University Press, 50*s*.), which promises fulfilment of our reviewer's requirements.—ED.]

The Witch-Cult in Western Europe. A Study in Anthropology. By MARGARET ALICE MURRAY. (Oxford: Clarendon Press, 16*s*.)

This is, we believe, the most extensive study of the subject yet made by a British anthropologist. Black-magic and devil-worship have existed side by side with established religion from the dawn of history. One is apt, however, to imagine that such things did not hold a dangerous sway in Great Britain after the introduction of Christianity till the fifteenth century. Such is not the case, and the reasons why we hear so much of witches in the fifteenth, sixteenth, and seventeenth centuries is due to the destructive attention that post-Reformation England and Scotland bestowed upon them at this time. It is from the records of the vast number of trials of witches during this period that most of our information is gathered.

Miss Murray has concentrated chiefly on the cult in Great Britain. In a masterly introduction she traces its origins to the ancient pre-Christian religion of Western Europe—a religion belonging to a race which "had not reached the agricultural stage," and whose deity either took the form of an animal, or of a man as in Italy, "where he was called Janus or Dianus," in Southern France and in the English Midlands. In connection with the latter form it is significant that the feminine equivalent of the name Dianus, i.e. Diana, was throughout Europe given to the "female deity or leader of the so-called Witches." The authoress outlines the festivals, organisation, connection with fairies, and the religious ceremonies of this Dianic cult, as she names it, and proceeds in Chapter I to illustrate how strongly it existed in England for many centuries after Augustine's mission and long after the country had been Christianised.

In the subsequent chapters a more fully detailed account is presented of the *God, Admission Ceremonies, The Assemblies, The Rites, The Organisation*, and *The Familiars and Transformation*, while some interesting appendices are added, including notes on fairies and witches, the trial of Joan of Arc, and a note by Professor A. J. Clark on ointments used by witches for the purpose of flying. One of these ointments contained both aconite and belladonna. With regard to this preparation Professor Clark says: "Irregular action of the heart in a person falling asleep produces the well-known sensation of suddenly falling through space, and it seems quite possible that the combination of a delirifacient like belladonna with a drug producing irregular action of the heart like aconite might produce the sensation of flying."

We wish that we had more space in which to review and extract illustrations from the mine of information contained in this book. It should find a place on the shelves of anthropologists, psychologists, and, last but not least, novelists who are in need of "atmospheric" details for mediæval and supernatural stories.

E. L.

Correspondence

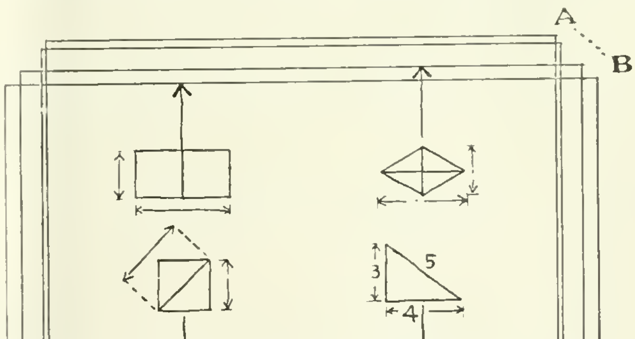
PRIMITIVE ARCHITECTURAL CANONS

To the Editor of DISCOVERY

SIR,

There can be no doubt that the proportions of primitive architecture were worked out on systematic lines, and probably with the aid of such figures as those suggested by Mr. Bowes in your January number.

I have made many attempts to get results in this connection, but have always been checked, firstly by the difficulty of getting exact data, and secondly by the ease with which apparent solutions can be found. There are many possible unitary figures, but even if we restrict ourselves to the four mentioned by Mr. Bowes, very slight



errors in the plan under investigation may lead us to wrong conclusions. This difficulty is illustrated by the attached diagram, which gives the four figures superimposed. It will be clear that any rectangular cells whose corners lie somewhere between the points A and B will in a large number of cases approximate very closely to one of the "unitary figures." When, in addition, we remember

that the old builders may have set out their work on the outside face, the centre, or the inside face of the containing wall, we realise that the chances of correspondence may be greatly increased since we have a choice of three slightly varying rectangles upon which we may apply our unit figures.

As an example of the second difficulty, we may take the "King's Chamber" in the Great Pyramid, where there is no question of a containing wall. Here, on the basis of the figures given—length 34 feet, height 19 feet, and width 17 feet—the floor embraces two squares of 17 feet and the height is almost exactly equal to half the full diagonal on plan.

This solution seems simpler than that suggested in the article, if we think in terms of practical building. Yet, without further proof from the Pyramid as a whole and from other examples, one cannot feel convinced that the builders consciously adopted either this or Mr. Bowes' unit for fixing the height. If we seek to find a key to the setting out of symbolic architecture, we must look for a system which pervades the structure as a whole in much the same way as engineering formulæ to-day are applied throughout a great bridge.

It cannot be enough to rest content with the discovery of isolated correspondences, many of which will naturally turn up in any series of complex buildings.

Yours, etc.,
F. C. Mears.

The College of Art,
Edinburgh.
December 1921.

To the Editor of Discovery

Sir,

I am glad to have had the opportunity of seeing the remarks of Mr. Mears, and wish to express my agreement with him in his plea for caution in accepting results which may possibly be due only to coincidence or incorrect data. The difficulty in obtaining reliable data is a very real one, and in investigating plans it is easy to be led astray by the choice of a wrong unitary figure. It is for this reason that I have confined myself to instances where measured dimensions are obtainable. The geometrical examination of a plan is a useful preliminary measure in the search for the type of unit, but the true test is the agreement of the calculated results with recorded measurements.

The diagram of four rectangles derived from different units, as drawn by Mr. Mears with their edges overlapping on all sides, minimises the real differences in size. It is not thus that one would compare the sizes of four envelopes or playing cards. Instead of trusting to the drawn figures it is safer to use the calculated proportions. For the rectangles formed from the four unitary figures named by Mr. Mears the ratios of width to length are as below:

3.4.5	1 to 1·333
Diagonal of square . .	1 ,, 1·414
Vesica Piscis . . .	1 ,, 1·732
Double Square . . .	1 ,, 2

With these ratios it is easy to investigate the measured dimensions. Agreement with dimensions, however, as Mr. Mears justly points out, may be merely due to coincidence. Corroborative arguments are desirable, and guidance in this direction may be found in matters which I have refrained from introducing—I refer to considerations derived from history, religion, tradition, mythology, and symbolism—in fact, from the sense of general fitness in the result. For example, Mr. Mears points out that "the height of the King's Chamber is almost exactly half the diagonal of the plan," the plan being a double square. This is mathematically correct, but the relation does not suggest any meaning or any reason for its presence. Also, it is not known to occur elsewhere. The 3.4.5 triangle, on the other hand, was intimately bound up with Egyptian art and thought. In religion its three sides were associated with the trinity of Isis, Osiris, and Horus. It was known as a practical expedient to their land-surveyors and architects from time immemorial, and in all likelihood they were acquainted with certain recondite uses of the triangle which, although they have been made public in the last few years, may still be said to be almost unknown to our age. One of the angles derived from it stands openly displayed in the slopes of neighbouring pyramids. The 3.4.5 triangle seems a particularly fitting symbol to be embodied in the King's Chamber, and until a better solution presents itself, I think we may leave it to occupy the position it now fills so adequately and unobtrusively.

Yours, etc.,
Arthur Bowes.

Wargrave,
Newton-le-Willows (Lancs).
January 1922.

UNEMPLOYMENT

To the Editor of Discovery

Sir,

Simply because I emphasised the fact that technical knowledge is very advantageous in the successful captaincy of a businesss enterprise, it by no means follows that I ignore the value of business capacity as regards the disposal of the goods produced, and general organisation, etc. I simply argue that it is possible to find men who possess both qualifications, even amongst those who have not the necessary capital at their command. I should like to mention also, as a reminder, the cases of large businesses which have originated from small "one-man undertakings"—Messrs. Lipton, for instance. Apparently, Professor Knoop has in mind, chiefly, the case of large engineering and shipbuilding enterprises, whereas I, perhaps, was thinking more particularly of those industries where hand-made (or hand-finished) goods of original design, superior craftsmanship, or introducing new inventions, have, even at the present day, a chance of competing with vulgar and flimsy machine "mass" production when the higher priced articles are concerned.

As regards the "economies" of large-scale production, in many cases the consumer never gets the benefit, because, the larger and fewer the business concerns are,

the better chance there is of forming a "ring" to inflate prices, and even where this is not so, the percentage is so small that it only benefits those people who are highly delighted at saving a halfpenny on an expenditure of about half a crown.

Yours, etc.,
GEO. McLAGGAN.

39 MORRIS ROAD,
LEWES, SUSSEX.
January 1922.

To the Editor of DISCOVERY

SIR,

Professor Knoop's article summed up very well the main causes of unemployment, except that, like other economists, he left out the one which one thinks should most readily occur to a contributor to DISCOVERY. That is the demonstrable fact that unemployment is an inherent condition of the existing method of production. I am not attacking that method; it may, or may not, be the best we can use at present, but we should, at least in a scientific journal, analyse the method, and see whether it is reconcilable with the full employment of wage-earning workmen.

In a manufacturing country like ours the incentive to production is profit. "Can I see a profit in it?" is the question upon which hangs the establishment or continuance of a business which involves the employment of "hands." If, after all expenses are paid, the article produced costs me a pound, and I can sell it for twenty-one shillings, well; if not, I invest my capital elsewhere.

Now this implies that, when the article has been produced and placed on the market, the wages paid—directly and indirectly—for its production will purchase only $\frac{20}{21}$ of the article. They cannot purchase the whole of it if there is to be a profit. One twenty-first ($\frac{1}{21}$) of its value goes to the man who finds the money. What does he do with it?

If he consumes it, all may be well; but on the whole he doesn't. At least a part of it accumulates, keeps on accumulating. It must, seeing that there is no possible purchaser of it. Week by week, month by month, the product and the purchasing power continue as 21 to 20, and the accumulation of unsaleable products goes on.

But it is of no use paying for the production of new goods while we have these old ones on our hands. Evidently common sense directs us to curtail new production for a time until the accumulated goods have been sold. And there is your unemployment—your inevitable unemployment. The ignorance, selfishness, and credulity of men, both operators and employers, may be trusted to increase this inevitable amount; but to say, as Mr. Ellis Barker does, that "there need not be any unemployment in this country," displays a want of understanding concerning the capitalistic, sale-and-purchase-of-labour system of production.

Yours, etc.,
E. BILTON.

January 1922.

To the Editor of DISCOVERY

SIR,

Mr. McLaggan is quite right in pointing out that many big businesses, such as Messrs. Lipton and Messrs. Lever Bros., have developed from small beginnings, if not actually from "one-man undertakings," but in these cases the necessary capital has been raised by converting the private undertakings into limited liability companies and inviting the public to subscribe for shares on the strength of the financial record of the firms. So far as the economies of large-scale production are concerned, I think that Mr. McLaggan underestimates them; the difference in price between a machine-made watch and a hand-made watch is much greater than a halfpenny in every half-crown. In the case of a few articles, a "ring" of big manufacturers may succeed in retaining for themselves many of the financial benefits of large-scale production, but that is probably the exception rather than the rule. In most industries there is keen competition between big producers at home and abroad.

With regard to Mr. Bilton's argument, it does not appear to be quite sound. It rests on the assumption that money is not actually spent, if it is received by a business man who does not lay it out on the purchase of necessaries, comforts, and luxuries for his immediate use, but saves and accumulates it. As a matter of fact, unless the business man hoards his savings, which is unlikely, they will be spent, directly or indirectly, in one way or another; e.g. (1) on buying new machinery, etc., for his works, with a view to extensions; or (2) on subscribing for new issues of governments or companies, which in due course use the money for the purchase of goods or services; or (3) on making a deposit at his bank, in which case the bank will employ the money in financing industry and trade, and the manufacturers and traders will use it for making purchases. Money that is "saved" is not a cause of unemployment.

Yours, etc.,
DOUGLAS KNOOP.

THE UNIVERSITY,
SHEFFIELD.
January 1922.

RACIAL INTERMARRIAGE

To the Editor of DISCOVERY

DEAR SIR,

I should be very much obliged if you would let me know of an article, pamphlet, or short book dealing with the effects of the intermarriage of Europeans and Asiatics, and of Europeans and Africans.

Yours etc.,
(Miss) E. M. RUTHBINTER.

GIRTON COLLEGE,
CAMBRIDGE.
November 1921.

[Notwithstanding the frequent references in popular literature to the character of the offspring of racial crosses, and, in particular, of crosses between civilised and backward races, little attention has been given to the scientific study of the mental and physical characters

of human cross-breeds. Professor K. Pearson published a short paper on the colour of crosses between negro and white in *Bimetrika*, vol. vi, 1909, pp. 348 sqq., and a study of Franco-Tonkinese crosses was published by Bonifacy in the *Bul. Mem. Soc. d'Anthropologie*, Paris, series 6, vol. i, 1910, pp. 607 sqq. The Germans before the war also devoted some attention to the question in their colonies in S.W. Africa. In the United States, the literature on the colour question deals with this point on the basis of impression rather than accurate observation, and is not unaffected by prejudices on one side or the other. Dr. Hrdlička, of the Bureau of Ethnology, was requested by the Government some years ago to examine anthropologically claimants to reservation lands on the ground of Indian descent, but I am not aware how far his investigations went or whether the results were published.—E. N. FALLAIZE.]

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY

Ancient Tales from Many Lands. A Collection of Folk Stories. By R. H. FLEMING. With Introduction by PROF. H. J. FLEURE. Illustrated. (Benn Brothers, Ltd., 10*s.* 6*d.*)

On the Edge of the Primeval Forest. Experiences and Observations of a Doctor in Equatorial Africa. By PROF. ALBERT SCHWEITZER. Translated by CH. TH. CAMPION. Illustrated. (A. and C. Black, Ltd., 6*s.*)

POLITICS AND ECONOMICS

A Revision of the Treaty. By JOHN MAYNARD KEYNES, C.B. (Macmillan & Co., Ltd., 7*s.* 6*d.*)

Common-sense Economics. By L. LE MESURIER. (John Murray, 6*s.*)

The New World. Problems in Political Geography. By ISAIAH BOWMAN, Ph.D. Illustrated. (George G. Harrap & Co., Ltd., 21*s.*)

PSYCHOLOGY

Disguises of Love. By DR. W. STEKEL. Translated by ROSALIE GABLER. (Kegan Paul, Trench, Trubner & Co., Ltd., 6*s.* 6*d.*)

Instinct and the Unconscious. By W. H. R. RIVERS, M.D., etc. 2nd Edition. (Cambridge University Press, 16*s.*)

The Technique of Psycho-analysis. By DAVID FORSYTH, M.D., etc. (Kegan Paul, Trench, Trubner & Co., Ltd, 5*s.*)

The Evolution of Consciousness. By A. WYATT TILBY. (T. Fisher Unwin, Ltd., 15*s.*)

SCIENCE

Indian Science Congress Handbook. (Printed for Ninth Indian Science Congress, Jan.–Feb. 1922, by the Madras Diocesan Press.)

Organic Chemistry. By VICTOR VON RICHTER. Vol. ii, *Chemistry of the Carbocyclic Compounds.* Translated by E. E. FOURNIER D'ALBE, D.Sc., etc. (Kegan Paul, Trench, Trubner & Co., Ltd., 35*s.*)

A Course of Practical Organic Chemistry. By T. SLATER PRICE, D.Sc., Ph.D., and DOUGLAS F. TWISS, D.Sc., F.I.C. 3rd Edition. (Longmans, Green & Co., 6*s.* 6*d.*)

A new edition of a useful laboratory manual.

Cassell's Library of Applied Science. Edited by GEORGE THOMPSON and GEORGE H. LESLIE, B.Sc. *Chemistry*, Part 1, 2*s.*; *Heat*, Part 1, 2*s.*

These books are "popular" in a good sense, intelligently and interestingly written and well illustrated. They contain little theory and no experimental work, and so are intended, not for the school-boy or student who wishes to pass examinations in these subjects, but for the intelligent reader whose main interests and studies lie elsewhere. They give final results, and describe how all the most interesting things in life work, are done, or are manufactured.

An Introduction to Engineering Drawing. By J. DUNCAN, M.I.Mech.E. (Macmillan & Co., Ltd., 4*s.*)

A new volume in the Life and Work Series of textbooks published to meet the needs of advanced study in elementary schools demanded by the Education Act of 1918.

Diet and Race. Anthropological Essays. By F. P. Armitage, M.A. (Longmans, Green & Co., 7*s.* 6*d.*)

Three essays—on Diet and Physique, Diet and Colour, and Diet and Cranial Form—by the Director of Education for Leicester. In the second essay the author advances the view that the presence of common salt in the blood retards or prevents the deposit of pigment.

Relativity for All. By HERBERT DINGLE, B.Sc. (Methuen, 2*s.*)

But relativity is *not* for all. Mr. Dingle's exposition is short and clear, and the book is cheap, but better for those able to follow it are the fuller and more general accounts given in Einstein's own book, and in one edited by Mr. Bird of the *Scientific American.*

THE author of *New Light on the Silver Age of Hellas*, which appeared in the January number, requests us to state that the name of Menander's play at the bottom of the first column, p. 9, should have been given by him as *The Arbitrants.*

DISCOVERY

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Binding cases for Vol. II, 1921, are now ready. Price 2*s.* 6*d.* net each; postage 9*d.*

Editorial Notes

FIFTY years ago Charles Darwin published a book called *The Expression of the Emotions in Man and Animals.* In many ways this book consolidated the foundations of the patient study, experiment, and research since bestowed upon the functions and nature of the ductless glands, or endocrine system, in the bodies of men and animals. In this direction remarkable discoveries have been made during the last half-century by English, American, and German physiologists, the results of which best known to the general public consist in the enormous relief afforded, by the feeing or injection of extract of the appropriate sheep glands, notably of the thyroid, to persons suffering from insufficiency of secretions from such glands. During the last few years some of the most striking researches in this problem of physiology have been made by British doctors and scientists, such as Langdon Brown [1] and Swale Vincent,[2] and in the field of experimentation with animals by Huxley and Hogben. Their work has shown the extreme complexity of the ductless glands in their relations with the rest of the human system, and how, after half a century's most careful study, we are only on the outskirts of a most baffling problem.

* * * * *

In its wider issues it connects up with the problem of personality, which is being probed from a different angle by psychologists. Undoubtedly we have in the past disregarded the body as a factor in personality, and have been inclined to consider it only as the casing round a soul almost completely dissociated with it. How far can we believe in such an idea in these days? Or, to put the question otherwise, how far are we entitled by purely scientific proofs to disbelieve in it? These are questions which the average man and woman have a right to ask of those scientists who are trying to hammer a way into the light, and who do not and cannot in their special work fall back on the "divine revelation" of any religion. No conscientious scientist can give them a definite answer to these questions. But a physiologist would probably tell them, "There is no doubt that the individual's physiological mode of reaction has a vast bearing on his mental life," and a psychologist that *vice versa* "the great effect of the individual's mental processes on his physical processes is beyond question." Further than this neither can rightly proceed at present. They are working from different angles. How far the two sciences can co-operate is a question to which we will return later.

* * * * *

Meanwhile there is always the danger of the extremist, who does infinite harm to his own cause, and to the general public. On the table before us lies a book entitled *The Glands Regulating Personality.*[3] In this book the author, so we are informed on the wrapper, "shows how man's individuality is controlled by the quality and quantity of internal secretions acting in him." The impression that his book seems intended to leave on the minds of educated but unscientific men is that personality or the human soul is entirely created and controlled by the endocrine glands and their secretions in the body; that the "types" of personality vary according as the body is dominated

[1] See *The Sympathetic Nervous System in Disease*, Chapter II, "The Sympathetic Nervous System in Relation to the Endocrine Glands." (Henry Frowde and Hodder & Stoughton, Ltd., 10*s.*); and a note on "The Position of the Thyroid Gland in the Endocrine System" (*Brit. Med. Journal*, January 21, 1922).

[2] See *Internal Secretion and Ductless Glands.* (Edward Arnold.)

[3] By Louis Berman, M.D. (New York: The Macmillan Company.)

by one of the endocrine glands more powerfully than by any of the remainder. In Chapter X Dr. Berman describes in detail these various " types "—" the adrenal centered, the thyroid centered, the thymus centered, the pituitary centered, the gonad centered, and their combinations." It is only fair to the doctor to say that he admits there are infinite modifications of these main types.

* * * * *

Now for one of the main types: " An adrenal personality is one dominated by the ups and downs of his adrenal gland. In the large, the curve of his life is the curve of secretion by this gland, both of its cortex and medulla. Such an adrenal personality is entirely normal, within the definition of the normal as something not threatening the duration of life, nor comfortable adaptation to it. So are the other glandular types. . . . The epidermis is always slightly, somewhat, or deeply pigmented. . . . The hair is . . . ubiquitous, thick, coarse, and dry. . . . When the pituitary type has a properly co-operating pituitary and thyroid, he possesses a striking vigor, energy, and persistence. With a fortunate combination, he develops into a progressive winning fighter, arriving at the top in the long run every time." And so on. By the end of the chapter the reader is, of course, trying to find which group of personalities he belongs or approximates to, and is in much the same state of mind as a person in a fortune-teller's booth. But, before he has time to recover his wits, he has been plunged into Chapter XI. In Chapter XI he is given extra proof of Chapter X. This proof consists in the application of the findings in Chapter X to " Some Historic Personages." Here he will learn that " the rise and fall of Napoleon followed the rise and fall of his pituitary gland " ; that " the physique and physiognomy of Nietzsche, his migraine attacks and the later fate which overtook him, his likes and dislikes, his tastes, abilities, and accomplishments followed from his composition as one pituitary-centered, with post-pituitary domination, a superior thyroid, and inferior adrenals " ; and that Oscar Wilde's aberrations may be accounted for by the fact that he was a " thymocentric " !

* * * * *

You see, it is all so easy and obvious, isn't it ? So easy and obvious, indeed, that we are constantly remembering the quotation from Francis Bacon's *Novum Organum* that Dr. Berman has placed upon his title page: " The passage from the miracles of nature to those of art is easy." But, when we come to look at the author's findings more closely, we begin to realise that many of them are entire speculation. Where are the facts, experiments, statistics on which Dr. Berman builds his simple edifice in Chapter X ? In illustrating his statements in Chapter X by historical examples in Chapter XI, the author appears to us like the man who got up in the market square and proved that the combination of the colours green and white produces the colour black by showing a piece of black paper which he declared was the result of the combination of white and green. In fact, we found no good reasons given anywhere for allotting certain " types " to certain glands, although abnormal activity of certain endocrine groups (e.g. pituitary, adrenal, and thyroid) can be demonstrated by physiological tests. It does not follow, of course, that Dr. Berman is wrong in associating certain mental types with, let us say, an abnormally active thyroid, but without any facts it is a big jump to say that the gland is the *cause* of the condition. In this connection lies the book's worst flaw—that it pays scarcely any attention to the fact that organs are apt to develop in response to the demands, including the mental demands, made upon them. Dr. Berman's purely physiological explanation of personality is unfair, one-sided, and untenable in these early days of research.

* * * * *

We cannot leave this most ludicrous yet dangerous piece of pseudo-scientific literature without mentioning in detail some of its many inaccuracies. On page 46 we are told that the thyroid gland swells " with sexual excitement, menstruation, and pregnancy " ; this is not a constant factor, and *all* the ductless glands play a part in phases of sexual activity. On page 48, that " Under the microscope . . . the thyroid shows remarkable and unique features " ; but these " unique " features are also found in the pituitary gland. On page 62 that " the pituitary is a lump of tissue about the size of a pea " ; but it is actually a good deal larger. On page 66 that " The giants and ogres of folklore and fairy-tales are favoured with the most extraordinary mental advantages " ; on the contrary, they are almost always represented as rather stupid and easily outwitted by the normal man or the cunning dwarf. On page 85 that " Removal of the thymus hastens the development of the gonads " ; this statement is not borne out by experiment. On page 188 that " The idea of repression, to the Freudian, means the pushing down into the subconscious of some experience " ; before criticising the poor old Freudians, Dr. Berman might at least have mastered their terminology ; " repression " means nothing of the kind ; the word " suppression " is used for this performance. Again, the conception of a physiological urge or tension as a moving factor in life is, of course, well known. Freud places this urge in the sexual glands ; Dr. Berman locates it in the endocrine system, the ductless glands, a theory which is not very logical, seeing that they are of comparatively late develop-

ment in evolution. Lastly, the whole endocrine system is so extremely complex and the different glands so closely interrelated in their functions that they cannot be rightly considered as separate entities. We venture to say that the deeper psychologists and physiologists go into the problem of personality, the more bewildered do they become at its psycho-physiological aspect. The only safe dictum to be made at present is that personality, character, call it what you will, is largely formed by the continuous action and reaction of mind and body upon each other.

* * * * *

We have dealt with Dr. Berman's book, and the questions that it raises, at some length, because it is symptomatic of the present dangerous age of transition in thought and mental attitude through which our whole society is now passing. Generally speaking, the average man and woman up to the end of the eighteenth century went to the Bible for guidance if he was up against questions concerning life or the universe. In Victorian times scientists began, for him, to usurp the place of the Bible; they were ready with the conceit born of newly acquired "knowledge" to put him right on most questions. What is the position now? Scientists, with their vast increase in knowledge, realise how very little they know about anything, and are not willing to give definite statements about the results of their work. Under the circumstances it is not surprising to find that many people are bewildered, and are not certain of where to turn in their efforts to adopt an attitude to life and its problems; that great numbers of our population are being driven, not even into an intelligent agnosticism, but into the most ridiculous extravagances of thought and practice, particularly in connection with the problem of human personality and its survival, by misinformed articles in the press, by pseudo-scientific books such as Dr. Berman's, and by the extremes of spiritualism.

* * * * *

It serves no useful purpose to be pessimistic about the present state of things. But effective remedies are urgently needed. We could not support the idea that a special censorship of popular scientific books should be established. Of more far-reaching importance would be the setting up of a Commission to collate the views of representatives of science, religion, and intellect concerning *The Problem of Human Personality*. The difficulties in the way of such an undertaking are sufficiently numerous and obvious to make the suggestion appear useless. Yet we feel that our journal represents a large body of people with active brains who have a right to demand an answer, however indefinite it be, from those men whose life's work is concerned with various aspects of that subject which has occupied the thoughts of mankind from the dawn of history. We should be glad to receive the views of our readers upon this matter.

* * * * *

All the members of the Mount Everest Expedition have left for India once more. What are their chances of success this time? Mr. Mallory put the question to Mr. Bullock before they parted after their attempt last year. His reply, after long reflection, was: "Fifty to one against." The chief obstacles in negotiating the final six to seven thousand feet appear to be the violent snow blizzards that swirl off the face of the peak and the extreme exhaustion and difficulty in breathing experienced at altitudes over 23,000 feet. The time-honoured principles of mountaineers must also be considered. As Mr. Mallory said in his paper[1] read before a joint meeting of the Royal Geographical Society and the Alpine Club last December: "A party of two arriving at the top, each so tired that he is beyond helping the other, might provide good copy for the press, but the performance would provoke the censure of reasonable opinion. If anyone falls sick at the last camp, he must be taken down with an adequate escort, and as soon as possible; and similarly on the final day. And coolies who become exhausted in carrying up their loads cannot be allowed to make their own way down."

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As against these difficulties, the climbers will probably have time to make several attempts on the peak, instead of one, and will also at the start be in "fresh" condition, and not exhausted by three months' climbing and life in high altitudes. Mr. Mallory mentioned another factor in favour of the assault: "The higher one goes, the less will be the effect of any given rise. To ascend the 3,000 feet above 17,000 is notably less laborious than to ascend the next 3,000 up to 23,000 feet; but the atmospheric pressure diminishes less rapidly as one goes up; consequently the difference in effort required between one stage and another should be less at each succeeding stage, and least of all between the last stage and the last but one. I believe it to be possible, at all events, for unladen mountaineers to reach 26,000 feet, and if they can go up so far without exhaustion, I fancy the last 3,000 feet will not prove so very much more tiring as to exclude the possibility of their reaching the summit."

[1] See *The Geographical Journal* for February 1922.

NOTICE

Professor Flinders Petrie wishes us to state that the dates of the Ist to VIIIth Egyptian dynasties, given according to the Berlin dating in a footnote to his article in the March number, should have been given according to the more correct Egyptian dating, i.e. as 5500–4000 B.C. For further information on this point, we advise our readers to see Flinders Petrie, *Historical Studies*, p. 22.

Lost Islands of the Southern Ocean

By R. N. Rudmose Brown, D.Sc.

In the waste of waters known as the Southern Ocean, which lie south of the three great inhabited continents of the southern hemisphere, the only land areas, beyond the great but little-known continent of Antarctica, are a few scattered islands, some merely detached portions of Antarctica near which they lie, but others tiny specks of land in mid-ocean. Few, if any, of these islands have permanent inhabitants; many of them are little known and imperfectly explored. Apart from the importance some of them, such as South Georgia and Kerguelen, have as whaling and sealing stations—for they have no other economic value—these islands are of scientific interest in throwing light on the distribution of plant and animal life and the former distribution of land connections in the southern hemisphere.

Particular interest attaches to certain islands that have been reported and found a place, albeit a doubtful one, on the chart, but have eluded searchers time and again. Do such islands exist, or were they simply born of imagination or illusion? There is little fine weather in the Southern Ocean; gales and heavy seas are the order of the day throughout the year, and under the lowering skies, particularly in midwinter, visibility is poor. Clouds or icebergs may be mistaken for land, and imagination may take strange forms. I have seen an icemaster, who had twenty years' experience of icebergs and their curious shapes, turn his ship off her course for an hour to make sure that a queer loom on the horizon was an iceberg and not a new island. Conversely it must not be forgotten that the poor visibility which is the rule makes the search for a reported island a matter of difficulty. On one occasion, when a few miles off a lofty volcanic island in the South Sandwich group, I saw no sign of land.

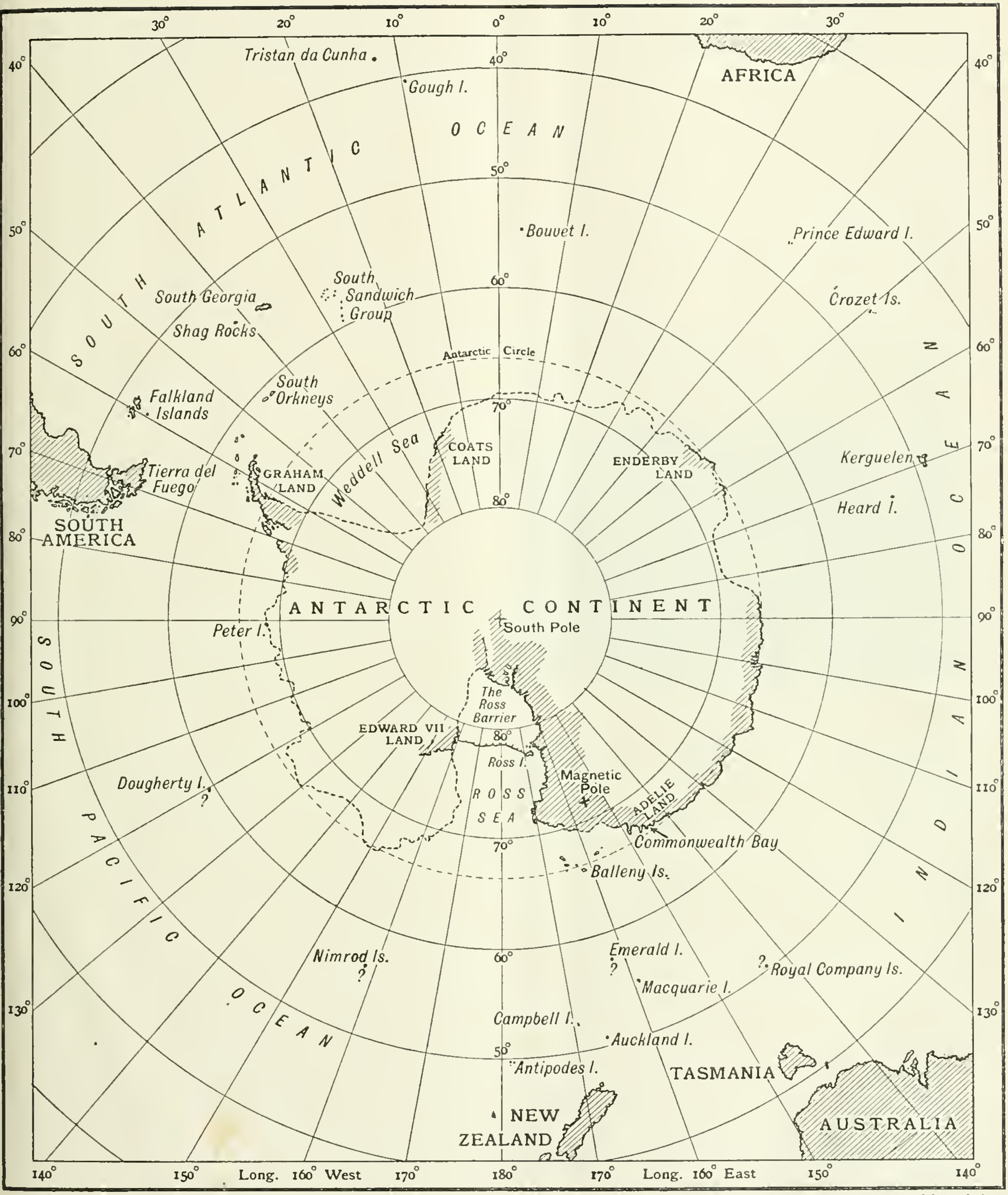
It is far easier for an island to find a place on a chart than to be removed therefrom. A few that figured for many years have already gone or might safely be erased. The Royal Company Islands were reported by a Spanish ship about 1776 to lie south-south-west of Tasmania in about lat. 49° S. and long. 142° E. No one appears to have seen them since, and exhaustive search in the neighbourhood on several occasions has failed to reveal them. Soundings within ninety miles of their reported position show a depth of over 2,000 fathoms.[1] But this fact cannot by itself be accepted as conclusive proof of the non-existence of land, since water of that depth is known to occur much nearer to certain other islands.

[1] *With the "Aurora" in the Antarctic.* J. K. Davis. London, 1919, p. 61.

Emerald Island, farther east and south in the same seas (lat. 57° 15′ S., long. 162° 50′ E.), was reported by a sealer in 1821. At a distance of some twenty-five miles he saw the semblance of an island about thirty miles long, rising into high peaked mountains. In all probability the supposed island was a cloud effect or possibly a gigantic iceberg. Search has failed to rediscover this island, but has shown that huge icebergs may occur in the locality. It has been suggested that Emerald Island was really Macquarie Island, lying about 250 miles to the north-west, for errors in position, especially as regards longitude, were not improbable among sealers a century ago. But, as the vessel after sighting this new island called at Macquarie Island, the explanation will not fit. There is no likelihood that Emerald Island exists. The Aurora Islands in the South Atlantic were reported in 1762, and twice later in the same century, to lie in about lat. 53° S., long. 48° W. This was clearly a case of mistaken longitude, and the Aurora Islands are doubtless identical with the Shag Rocks, a tiny group of jagged rocks, some 150 feet high, the haunt of many sea-birds, but untrodden by man.

Another group which may have to be removed from the chart are the Nimrod Islands, said to have been discovered in lat. 56° 30′ S., long. 158° 30′ W., in 1828 by the ship *Nimrod.* They were sighted at some distance. This position, being well within the limit of floating ice, is off the track of vessels crossing the Southern Pacific, but more than one explorer has sought in vain for the group. Biscoe, however, in 1831, reported many birds and much floating vegetation on the site, but Davis in 1909, strangely enough in another *Nimrod,* found no sign of land. An error in longitude may have displaced this island group many miles. There is yet no proof that it does not exist, although Davis found a depth of 1,140 fathoms within sixteen miles of its reported site.

The case of Dougherty Island, farther east and in a higher latitude than the Nimrod group, presents features of more interest and is not a little mysterious. In lat. 59° 30′ S., long. 100° W., American sealers are said to have known an island called Swain's Island, where at least one cargo of seals was obtained. This was about 1800, and the island seems to have been forgotten when sealing in Antarctic waters was given up. In 1841 Captain Dougherty, in command of a whaler, sighted, at a distance of about 400 yards, an island five to six miles long, with a high bluff at the north-east, and fairly low land at the south-west. Between was a valley covered with snow. He gave its position as about lat. 59° S., long. 120° W. Captain Keates in 1859 sighted a round island about 80 feet high in much the same latitude, but thirty-four miles farther east. Then comes the most remarkable part of the



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story. In 1886 the barque *Cingalese* was close to the island for three days. Her captain described it as six miles long, rising to 300 feet in the north-east, ragged at the south-west, and devoid of snow or vegetation. In 1890 he saw it again. In spite of these circumstantial accounts all recent attempts to find an island in that locality have failed. In 1894 the s.s. *Rimutaka* searched in vain along the parallel of lat. 59° 24′ S. for 144 miles, and the same vessel tried again on other occasions, but with no success. Captain R. F. Scott in 1904 found a depth of 2,318 fathoms on the site of the island[1]; Davis in 1909 searched in vain for land[2]; and the *Carnegie* in 1915 could not find it.[3] The late Sir E. H. Shackleton had intended to search once more for this elusive island on the present voyage of the *Quest*.

THE LANDING PLACE ON THE COAST OF GOUGH ISLAND. THE *SCOTIA* IN THE DISTANCE.
Photo by W. S. Bruce.

That an island can elude the explorer to such an extent that doubt is cast on its existence is shown in the case of Bouvet Island. In 1739 the French Captain Bouvet, searching for new southern lands with which to trade, sighted land in lat. 54° S., long. 4° 30′ E. Pack-ice prevented a nearer approach than twelve to fifteen miles, but Bouvet described his discovery as high snow-covered land, extending E.N.E. from a lofty headland for some twenty-four to thirty miles. The coast appeared to be steep. Believing that he had found the long-sought southern continent, Bouvet named his discovery Cap de la Circoncision. His second ship gave a slightly different position, and held that the land was an island. Captain James Cook in 1774 could not find Bouvet's land, which remained a half-credited myth till 1808, when Lindsay, a sealer, discovered an island the middle of which he placed in lat. 54° 22′ S., long. 4° 15′ E. He described it as some fifteen miles long, high in the west and low in the east, mainly snow-covered, but bearing some trees or shrubs. Ice prevented a close approach. This was clearly Bouvet's land, but an island and not part of a continent. A few years later, in 1825, another sealer named Norris reached the island, and finding it free of ice, made a closer examination. In lat. 54° 15′ S., long. 5° E., he found a high snow-clad island, fringed by a steep coast. In ignorance of Bouvet's discovery of nearly a century earlier, Norris named this Liverpool Island. On account of bad weather, he did not attempt to land. But now comes the curious part of his story. A few days later he sighted another island, forty-five miles to the north-east, which he named Thompson Island. He described this island as bearing "evident marks of having been a volcano, as it is nothing less than a complete cinder. . . ." His boats were sent round the island in search of seals. They were weather-bound for six days on the island, and a landing was made on the south-west, which appeared to be the only possible place. A further discovery by Norris was a group of three isolated rocks, the Chimneys, five miles south-west of Thompson Island. It is difficult to discredit this story of Norris's, but his second island has remained hidden to this day. Ross could not find Bouvet Island in 1843, on his return from the Antarctic with the *Erebus* and the *Terror*, but that was not surprising, since he, like Cook, looked too far to the east. It was not until 1898 that it was rediscovered, this time by the German exploring vessel *Valdivia*, which searched for and found Bouvet Island, not in the position assigned to it, but some miles farther west, viz., in lat. 54° 26′ S., long. 3° 24′ E. Captain Krech found it steep and inaccessible, rising to a height of over 3,000 feet, and not more than five miles across at its widest part. A photograph shows it to be covered with a snow or ice cap. The *Valdivia* could find no other island in the vicinity. Since then there is no report of the island being sighted, and it must still be regarded as uncertain whether a second island exists. Probably the *Quest* will throw light on the problem. From what is known of the submarine relief of this part of the ocean, there is nothing improbable in the occurrence of a group of islands in the neighbourhood. A submarine ridge with water under 2,000 fathoms in depth seems to cover this part of the Southern Ocean.

[1] *Voyage of the "Discovery."* R. F. Scott. London, 1905, ii, p. 401.

[2] "Voyage of S.Y. *Nimrod.*" J. K. Davis, *Geographical Journal*, December 1910.

[3] According to the *Geographical Journal* (February 1921), Captain Dixon, of the s.s. *Canadian Navigator*, in 1918 failed to find either the Nimrod Islands or Dougherty Island, although he was favoured by conditions of good visibility during his search. A marked increase in the number of birds and some kelp were observed to the west-south-west of the supposed position of the Nimrod Islands. These may possibly be indications of land in that direction.

This ridge is probably a branch of the great mid-Atlantic ridge, along which several volcanic cones rear their crests above the waters of the ocean.

Of these groups the most interesting is the little Tristan da Cunha group, of which several are well-known and one, Tristan da Cunha, is inhabited. An outlying, seldom-visited member of the group is Diego Alvarez or Gough Island. This island was a Portuguese discovery in the days of their great voyages to the East, but when Captain Gough in 1731 reported an island some degrees east of Diego Alvarez, the new discovery found a place on the charts as Gough Island, and it was long before the identity of the two islands was recognised. Being more or less on the route of sailing ships from the Atlantic to the Indian Ocean, this island was never lost sight of, but throughout the nineteenth century it was visited only by a few sealers and one or two warships from the Cape station. The visit of H.M.S. *Royalist* in 1887 resulted in a rough chart of the island. But practically nothing was known of its structure, fauna and flora, when in 1904 Dr. W. S. Bruce, on his return from the Antarctic in the *Scotia*, landed an exploring party. This visit resulted in many discoveries of scientific importance, but the exploration of the island is still incomplete.[1]

To return to the sub-Antarctic islands of the Southern Ocean—for Gough Island is temperate in climate and vegetation—there is one very isolated group that still awaits thorough examination. The South Sandwich group lying south-east of South Georgia, between the meridians of 26° and 28° W. and the parallels of 56° and 60° S., was first sighted in 1775 by Captain Cook. A subsequent visit in 1820 by Captain Bellingshausen accounts for the many incongruous Russian names on the chart of the islands. The group consists of some eight small volcanic islands, among which are several active volcanoes. In recent years these islands have rarely been visited, except by a few sealers and whalers. Stormy seas and apparent lack of good harbours make the task of exploration difficult. The whalers even avoid these waters.

It is unlikely that any further islands remain to be discovered in the Southern Ocean. Yet it is not impossible that east of the South Sandwich group, between it and Bouvet Island, the South Atlantic ridge may have a southern extension on the summit of which some tiny volcanic island may exist. On her northward voyage along the meridian of 10° W. in 1904, the *Scotia*, on one occasion in particular, met great flocks of seabirds, the presence of which in numbers is a fair indication of the proximity of land, but heavy weather and low visibility in autumn days prevented an adequate search.

[1] "Diego Alvarez or Gough Island." R. N. Rudmose Brown. *Scottish Geographical Magazine*, August 1905.

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Memory, and Its Improvement

By Robert H. Thouless, M.A.

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THE experimental investigation of the processes of remembering and forgetting is one in which advances have been made fairly continuously during the course of the last thirty years. My main purpose in the present article will be to call attention to the most recent developments, and to the aspects on which attention is focussed at the present day, and in connection with which important discoveries may still be made. In order to do this, however, it is necessary for the sake of completeness to mention work on the subject which is no longer recent. These parts of the subject I propose to mention as briefly as possible.

The person who is not a psychologist is mainly interested in one problem of memory—the question of whether or not the psychologist can tell him of any way by which his memory can be improved. This being the case, he will naturally be disappointed to find that the earliest contribution of empirical psychologists to the subject was the dictum of William James (often repeated since on no good experimental evidence) that his memory is not capable of improvement ; that, although he may improve his methods of learning, or other factors incidental to the successful employment of his memory, his memory itself will remain as it was. The way that James states this fact is as follows : *No amount of culture would seem capable of modifying a man's* GENERAL *retentiveness*.[2] Later he calls this general retentiveness *the faculty for remembering facts at large*. The discouragement felt by the person who has spent valuable time and money on systems which advertised that they would improve his memory is only a little mollified by finding that he is further told that his remembering may be made better by improved methods of learning.

Yet the mere wording of this dogma carries in itself a warning to the psychologist impregnated with the modern point of view. The word *faculty* implies that we are thinking of the memory as a separate part of the mind with which we remember, just as the hand is a part of the body with which we grasp things, and the leg is a part of the body with which we kick or walk. For a long time psychologists did regard the mind as made up of such separate faculties of memory, imagination, etc., until it was understood that such faculties have no real existence, and are only results of the vicious habit of mind which takes words from

[2] *Principles of Psychology*, vol. i, p. 664.

popular speech and supposes that they stand for real things. The truth is that it is one mind which is at one time remembering, at another imagining, at another doing both of these at once, or performing some other combination of its numerous functions. We may still use the word *memory* as a convenient term for including all the mental functions which result in the recall of past experience, but *memory* as a faculty about which we can either assert or deny the possibility of its improvement by practice must be dismissed as a myth which modern psychological thought has outgrown.

Perhaps the force of the objection to this conception of the faculty of memory will be felt most strongly if we stop to consider the wide variety of mental functions which may be exercised when we remember. Let us take a few examples.

First, I will ask you to remember the date of the Battle of Hastings. 1066 jumps to your lips almost before you have had time to think. It is unlikely that you either saw or heard the date in your imagination, although some people would do so. What has happened is that a habit of repeating " Battle of Hastings, 1066 " was so engrained in your mental constitution by constant repetition in your school-days, that the idea of the Battle of Hastings immediately causes the discharge of the appropriate motor response *ten sixty-six* without any intervention of a conscious process, except, perhaps, the very vague feeling of the muscular movements necessary to make the word.

Secondly, will you try to remember whether some familiar figure, let us say the clerk who usually attends to you at the bank, has a moustache ? For those who are not ready visualisers this will be found to be rather a difficult operation. The method which we all adopt (if, as I am assuming, we have never particularly noticed whether he has one or not) is to call up a visual image of the person in question. This may be clear and distinct, or dim and vague, according to our powers of visualisation. We then try to see whether this image has a moustache, and, if our picture is too indistinct for us to be certain, we may experiment by trying to picture his face with and without a moustache, until we feel that we can recognise the image as a true representation. If, as a result of our inspection, we feel ourselves able to say confidently that the man has a moustache, we say that we have *remembered* this fact.

As a third example of remembering, we may take what remains of the present article in your mind twenty-four hours after you have finished reading it. It is improbable that it will have been entirely obliterated from your mind ; in ordinary speech, you will say that what remains of it in your mind is the part you remember. If you try to see how much of it you can consciously recall at that time, you will find yourself going through a very different mental process from that involved in either of the two previous examples. You will, for example, probably be unable to recall any part of the visual experience of seeing the actual words of the article by means of visual images. If you can recall vaguely what the article looked like on the page, that will be no help to you in remembering it. Essentially you will be recalling the meaning of its different parts, and the logical connections between them. You may be able to do this quite successfully, even if you can remember none of the words of it at all, and if you succeed in doing this you will say that you remember the article.

We have, then, in three cases of remembering, three totally distinct kinds of mental activity, which we may at first be tempted to say have nothing in common except their name. What they have in common is, in fact, no psychological property, but the fact of practical importance only, that they all happen to be methods of discovering things about our past experience. The word *memory* owes its existence to the practical convenience of grouping together in speech all the mental activities used in the recall of past experience. The existence of the word does not justify us in supposing that all of these activities are in any psychological sense all of the same kind ; still less does it justify us in supposing that there is some mysterious entity, *the memory*, about which we can make general statements such as the one which we began by criticising.

Of course, having decided that there is no such thing as a *memory*, we shall go on using the word very much as before. We shall still feel the practical convenience of being able to group together in speech all the mental activities connected with the recall of the past. But this preliminary discussion will have robbed the word of its power to mislead us, to make us believe that behind the *word* there is a *thing*.

This is not, as perhaps it sounds, a question of merely academic interest. It is one whose proper understanding will vitally affect our attitude towards all the practical problems of memory. We need not, for example, concern ourselves with the question of whether our memory itself, as distinct from the ways we have of remembering, is capable of improvement by exercise. It is seen to be a question devoid of meaning, for no such thing exists as a *memory* in the sense presupposed by the question. The distinction between the memory itself and other factors in the successful recall of past experience is invalid. These other factors are such things as : the attention we gave to the experience at the time of its happening, our methods of observation or learning, the imagery by

means of which recall takes place, and the organisation of the existing mass of knowledge into which the new experience is to be received. It is, to say the least, an open question whether all of these factors may not be improvable. If they are improved by our efforts, we have made our power of remembering greater ; in other words, our memory can be said to have been improved in the only sense in which that phrase can ever bear any real meaning.

If all of this be admitted, the problem of improving the memory resolves itself into the problem of discovering how to improve our ways of remembering. A considerable amount of work in experimental psychology has been devoted to this question because of its importance in pedagogy. In the space at my disposal it will be possible only to give a brief outline of the discoveries which have been made, and of these I propose to discuss only those which have practical bearings. We may take each of the above four factors in turn and examine the grounds on which we may believe in its improvability.

Perhaps the most obvious of the variable factors which affect the efficiency of our memorisation of a task is the amount of attention we give to it. The variability of the factor of attention can be strikingly shown by the fact that the efficiency of learning is sometimes increased by such a distraction as an external noise. This is apparently because the presence of the distraction makes the learner concentrate more intensively on his task. The importance which we all attach to this factor is fully justified by the results of experimental work. An intense, fairly uniform and persistent concentration of attention is necessary for efficient learning. This can be secured partly by interest in the subject to be learned, or merely in the act of learning. In the learning of nonsense syllables, and to some extent in all learning by heart, this concentration of attention must take place by voluntary effort. The power of making such an effort effectively appears to be one which can be very much improved by practice. The effectiveness of the concentration can also be increased by due precautions as to the conditions of learning, e.g. by avoiding the making of such long sittings that fatigue is seriously interfering with the concentration of attention.

The investigation of memory has revealed two distinct types of learners whose essential difference is supposed to lie in the nature of their attention. These are rapid and slow learners. The first learns quickly and easily, is readily disturbed by outside distractions, and forgets quickly. The slow learner, on the other hand, settles down to his task with difficulty, learns slowly, is little influenced by distractions, but retains what he has learned better than the other. The difference appears to be that the rapid learner is able quickly to concentrate attention on one task to the exclusion of others, the slow learner adjusts his attention less quickly and less exclusively. They may be said to be respectively *intensive* and *extensive* in their attention. It is difficult to say that one of these characters is more desirable than the other, since clearly both kinds of attention are valuable, but in different situations and in different walks of life. A German psychologist, Meumann, has suggested that they are not mutually exclusive qualities, and that the most desirable type of attention is that which combines both. In this case, both intensity of attention and extensity should be independently trained in order to obtain the highest efficiency in learning.

In order to illustrate the contribution which laboratory study can make to our knowledge of efficient methods of learning, we may take the question of the *part* and the *whole* methods. This is now so generally understood that a very brief reference to it will suffice. The uninstructed person, required to learn a long poem by heart, adopts what is called the *part method* ; he divides the poem into sections of such a length that he can conveniently learn one at one sitting, he learns these at successive sittings, and finally learns them combined. Experiment proves conclusively that, despite the wide prejudice in its favour, this is a very inefficient method. The alternative method, in which the whole poem is read through at each sitting a few times or only once until it is learnt, is found to require a smaller expenditure of time and to result in a more efficient memorisation. It is not difficult to see why this should be the case. There are many elements of waste in learning by the part method ; the formation of unnecessary associations between the end of each verse and its beginning which must be unlearned when the verses are connected together, the greater number of repetitions of the earlier verses, and the inefficient distribution of the times of repetitions.

Of course, these conclusions must be applied practically with reasonable respect for the peculiarities of individual cases. Some persons find the task of facing the whole of a long poem at once so discouraging that the whole method ceases for them to be effective. This discouragement, however, should disappear if we can convince them that this is really the easiest way of learning it ; and against this possibility of discouragement must be weighed the fact that this method is certainly less tedious than the alternative of repeating over and over again small sections of the poem. In addition, it would clearly be unwise to use the whole method in its simple form if the material we were trying to learn were of very unequal difficulty in its different parts, for the easier parts would receive an unnecessary number of repetitions. In this case, a modification of the whole method may be devised

in which the most difficult parts receive more frequent repetitions than the others.

This is only one way in which remembering can be improved by the use of better ways of learning. I will mention a few others without discussing them in great detail. That the deliberate intention to remember is a vital factor in effective learning is a fact which has forced itself on the notice of experimenters on memory; but it is so widely believed outside the laboratory that we need not dwell on it. It has also been proved that a given number of repetitions of the material to be learned spread over a considerable length of time is more effective than the same number crowded together. This is one reason for the superiority of the whole over the part method, for it is clear that this condition is better fulfilled in the former method. Moreover, it must not be forgotten that autosuggestion is a factor which may influence the effectiveness of our remembering. Confidence that we shall succeed in retaining what we are trying to learn is the best condition for successful retention, while an attitude of doubt and distrust of the powers of our memory tends to make retention unsatisfactory. *Probably it would be no exaggeration to say that, every time a person remarks that he has a memory like a sieve, he is knocking one more hole through its bottom.*

It was mentioned earlier that one direction in which we might look for possible improvements in remembering was in the employment of mental imagery. This is a problem which will take us further into the field of modern psychological interest. Unless they have been interested in psychology, few people will be found to have any idea of the enormous difference between the minds of various people in their content of imagery. It is easy and natural to assume that other people think and imagine in much the same way as we do. That this is not the case was proved first by Francis Galton, who questioned a large number of people about the power they had of representing pictures of things before their mind's eye. In this power of *visualisation*, or the employment of *visual imagery*, he found astonishingly wide variations. Some persons stated that they could see things in this way as vividly and distinctly as they could see things which were really present. Others (particularly, Galton noticed, scientific men) denied that they had any such power themselves, and refused to believe that other people had. As a result of his researches, Galton came to the conclusion that people could be divided into three classes: the *visiles*, who had such imaginary representations of things seen; the *audiles*, who had imaginary representations of sounds; and the *motiles*, who had imaginary representations of movements. Later research has, on the whole, confirmed Galton's conclusions, although it has shown that their explanation is not so simple as he was led to suppose. In particular, it has been shown that people generally differ in the kind of imagery they use in imaging words and in imaging actual things. It has also been shown that people are by no means constant even in the kind of imagery they use for actual objects. This may vary with the nature of the object. At the same time, it is found to be true that most persons use one kind of imagery more readily than others. If we say, for example, that a person is of the *concrete visual* and *verbal auditory* type, we mean that he habitually images actual things by means of pictures, while he images words by their sound.

These differences come out very clearly in memory experiments. If we study the methods by which different people learn nonsense syllables—the ordinary material for memory experiments—we shall find that a few of them recall the syllables by forming a visual picture. We discover that this is the way they are learning when we find that they tend to mistake words which look alike. We find also that they can reproduce the syllables backwards as easily as they can in their correct order, a very difficult task for people who learn by any other method. Others use auditory images. These learn most easily if the syllables are read to them, or if they may read them aloud. They tend to mistake letters which sound alike, and their learning is generally seriously disturbed by an external noise which would not disturb the visualiser at all. Most commonly of all, we find persons who learn the syllables by means of motor imagery. These pronounce the syllables to themselves, and recall them by the feeling of the movements of mouth and tongue which are necessary in order to say them. These find learning easiest if they are allowed to read the syllables aloud, though this is not necessary. On the other hand, their learning is always seriously disturbed if they are compelled to perform some action, such as whistling or rapid swallowing, which prevents them from making the muscular movements of pronouncing the words.

In most tasks various kinds of imagery may be used, though they are not all equally efficient. It is obvious that the visualiser is at an advantage in remembering visual impressions, the person with auditory imagery in remembering sounds. Even in the memorising of nonsense syllables, there are characteristic differences between the performances of people with different kinds of imagery. The person using visual imagery in such learning is found to be slower but to be more accurate in his reproduction and to be more certain than the person who uses the more common auditory-motor method of learning nonsense syllables.

These facts show how important is the question of whether any method of training can make it easier for

us to use a kind of imagery which is not our dominant one. This is not a question which can be answered with certainty at present, but all the indications of experimental work seem to point in the direction of an affirmative answer. For example, long-continued learning of nonsense syllables by reading aloud or to himself makes the subject of a memory experiment approach to the auditory-motor type. Meumann states that he began by being predominantly non-visual in his learning of verbal matter, but that he cultivated visual ideation to such an extent that he was able to learn with it as well as with auditory or motor imagery, and he found that his visual learning was slower but more sure. That training can influence one's imagery is assumed by those systems of memory training which give exercises in visualisation, requiring their pupils to practise the mental picturing of past scenes and the discrimination of the details of those scenes. We must wait, however, for more extensive experimental investigation of the subject before we can be sure of the effects of such training.

A knowledge of the difference between the ideational types also enables us to understand the difficulty which some persons have in remembering certain things, although they appear to have in other respects what we call a *good memory*. Meumann tells the story of a boy who was trying to draw a map of Greece. Although he studied the map carefully by looking at it, his reproduction was a mere shapeless blob. Meumann surmised that he was of the motor type, and made him trace the coast-line with his finger. The boy was then able to reproduce the map without difficulty.

The last factor to be remembered in efficient memorisation is the part played by the previous organisation of the mind in its reception of new material. New knowledge is better remembered when the mind receiving it is already stored with related ideas by means of which the new matter may be at once understood, assimilated, and brought into order. This is a factor in remembering which can certainly be made increasingly efficient. I suppose that the prime object of the education of children is to increase their power and ease of learning by such an increase in their mind of the number of ideas which are already assimilated and ready to be related to any new knowledge which comes along. Let us imagine that a child of fifteen who has received an ordinary school education, and another child of the same age who has learned to read, but is otherwise uneducated, are both presented with a simple account of some facts equally new to both of them. It will be found that the account will be much better retained by the educated child. This will still be true, if the account be of such a simple nature that, in reading it, the uneducated child is able to understand it perfectly easily in every part. The difference is due to the mass of related ideas in the mind of the educated child into which the new information can be fitted.

The question with which we started this discussion of memory was the question of whether psychological research gave us any hope of improving our memories. The answer seems to be very decidedly in the affirmative, despite the pessimism of William Jones. We have discussed four factors in remembering: the attention, methods of learning, the imagery used in remembering, and the organisation of the existing body of knowledge in our minds. It is certain that most of these factors are improvable, and it is probable that all of them are. And, when we realise that the faculty of memory as distinct from our methods of remembering is merely a myth of out-of-date psychology, we must conclude that the improvement of our methods of remembering is the improvement of our memory.

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The Life of a Radio-Element

By A. S. Russell, M.A., D.Sc.

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RADIO-ACTIVE elements differ notably from ordinary matter in that they lack permanence. The ordinary elements seem made for all time; not so the radio-elements. They change. Each has a life; of some it might almost be said they have a career.

A radio-element is usually defined as one which emits spontaneously a α- or β-particles. Atoms which emit these particles are said to disintegrate. The α is a particle of matter which is equal in weight to four hydrogen atoms, carries two charges of positive electricity, and is expelled from the centre of the atom with a velocity of about 20,000 miles per second. The β is a single charge of negative electricity (and

therefore has a negligibly small mass), which is expelled with a velocity which varies from about 50,000 miles per second to that of light itself. A radio-element lacks no property which is characteristic of an ordinary element. Its properties are exactly those to be expected from its atomic weight, and are indeed those it would have, were it not radio-active. The properties which are associated with the name "radio-active" are additional properties, extras. Lack of permanence, as we shall see, is one of these.

The study of radio-activity in the last twenty years has supplied experimental proof of the individual existence of the atom as a real unit in the structure of matter. (It is true that for more than a hundred years chemists have found it extremely convenient to postulate the existence of atoms, but it is only in our own day that the physicists have been able to demonstrate that atoms really do exist.) An element therefore consists of an assemblage of atoms. A radio-element differs from one which is not radio-active in that in a given interval of time, say a second, a definite fraction of the total number of its atoms happen to disintegrate. Each disintegrating atom expels either an α- or a β-particle and becomes in consequence an atom different from what it was prior to the act of disintegration, or, what is the same thing, from an atom that has not disintegrated. A radio-element consequently contains always two kinds of atoms, those that have disintegrated, and those that have not. Those that are unchanged comprise the pure radio-element which is known as the parent; those that have disintegrated comprise a new element known as the product. The product is perfectly distinct from its parent in physical and chemical properties, and can be easily separated from it by the ordinary methods of analytical chemistry. If now the product happens, like its parent, to be radio-active, a certain fraction of it will disintegrate per second to form its product, a third substance, and this body, if radio-active, will produce a fourth, the fourth a fifth, and so on, till a body is reached which has not the power of disintegrating, when the series of elements abruptly ends. Such a series is called a disintegration series, and three of these are known at the present time. In a disintegration series each element but the last is the parent of the one that follows, and, except the first, the product of the one that precedes. The first body, the head of the series, is called a *primary* radio-element, or sometimes the original parent. Uranium and thorium are two of the three primary radio-elements.

It must be pointed out that a radio-active body never disintegrates "all at once." The process may proceed quickly or slowly according to the properties of the element disintegrating, but it always proceeds according to one settled plan. In a given interval of time there is always a definite fraction of the atoms of each radio-element which disintegrate, and this fraction is invariable. It is the same whether there be a million million atoms present or a million only; no chemical combination with other atoms—or physical agency such as change of pressure or of temperature—seems able to affect the value of this fraction in the least degree. The fraction for the best known radio-element, radium, is $\frac{1}{2309}$ per year. This means that if we were to weigh out 2,309 pounds (or any other unit of weight) of radium to-day, in a year's time 2,308 would remain absolutely unchanged and 1 would represent the weight of products into which the radium had disintegrated. Expressed otherwise, 99·95 per cent. (if you work it out) of the radium fails to show any sign of radio-activity in the course of a year, so that the radio-activity of radium is due to a very small percentage of itself. Most radio-elements disintegrate more rapidly than radium; five disintegrate more slowly.

Let us now consider the matter more in detail. Suppose a body disintegrates so rapidly that time may be conveniently reckoned in days instead of in years. We shall imagine that the fraction which disintegrates each day is 10 per cent. It must not be deduced from this that the whole of the body will consequently disappear in ten days. The percentage that disintegrates each day is calculated on the actual number of atoms of the radio-active body in existence at the beginning of that day. Let there be 1,000,000 atoms at any particular time, then exactly a day later there will be 900,000, after two days 810,000, after three days 729,000, after four days 656,100, after five days 590,490, after six days 531,441, and after a week 478,297. Each of these numbers is 10 per cent. less than the number which precedes it. All radio-elements, when pure, disintegrate according to a scheme of this kind. The fraction that disintegrates daily varies enormously for the different elements, but for each element, as has been said, it is invariable. For equal intervals of time (in the example, one day) the ratio of the number of atoms of the original radio-element at the end of the interval to that at the beginning is constant (in the example $\frac{9}{10}$). This is the law of disintegration which governs all known radio-active changes. It is sometimes stated in this form: as time *increases* in *arithmetical* progression, the number of atoms *decreases* in *geometrical* progression. In Fig. 1 the type of curve obtained by plotting the number of atoms (or the activity) against the time for the radio-element uranium X is shown. It is known as a decay-curve.

There are two interesting consequences of this law which are not obvious, but which will nevertheless be mentioned. The first is that, although the number of atoms comprising the radio-element change with

time, an atom *may* exist unchanged for any time from zero to infinity. There is, however, for each radio-element an "average life" of so long and this in years, days, hours, etc., is numerically equal to the reciprocal of the fraction that disintegrates per year, per day, per hour, etc. The second is that for each radio-element there is a constant interval of time at the end of which the number of atoms, at its beginning, has fallen (through disintegration) to half. This is called the half-value period, and is the unit in which the life of a radio-element is most often expressed. Between the fraction disintegrating, the "average life," and the half-value period are simple numerical relations; the reciprocal of the fraction disintegrating is the "average life," and that multiplied by the factor 0·693 is the half-value period. In the example above the fraction disintegrating is $\frac{1}{10}$th per day (10 per cent.). The "average life" of the atoms is 10 days; the half-value period 6·93 days. In this last period the million atoms become 500,000, in 13·86 days 250,000, in 20·79 days 125,000, and so on. The fraction for radium is $\frac{1}{2300}$ per year; the "average life" of radium atoms is 2,309 years, the half-value period 1,600 years. If an ounce of radium had been separated from its ore about 1279 B.C. it would have weighed half an ounce in 322 A.D., and a quarter of an ounce to-day, and this weight will fall regularly by half every 1,600 years so long as the universe continues.

Thorium has the longest half-value period of all, 15,000,000,000 years; uranium comes next with a third of this amount. These are enormous and almost unthinkable periods of time. Three bodies have periods reckoned in hundreds of thousands of years. Next comes radium, with a period of a thousand years or so, and next actinium, with twenty years—the only radio-element whose period approximates to the life of man. Most radio-elements have periods less than a year, and some are very short indeed; that of the element known as thorium A is ·14 of a second, so that in seven times that period (a second approximately) the amount of this element falls in the ratio of 128 to 1. Thorium A consequently has a short life, but, no doubt, a merry one. Yet it is long compared with that of the element thorium C, whose period is ·00000000001 of a second. It is only right to add that this short period has not been measured directly; it is calculated, however, from trustworthy evidence. The shortest period directly measured is that of actinium A, a mere five-hundredth of a second!

It may well be asked how it is, if the world be old and the half-value periods of most radio-elements short, that these bodies exist at the present day at all. To this, in short space, it is not easy to make reply. Consider, first of all, the long-lived primary elements, thorium and uranium. They are rare elements, becoming as time goes on still rarer. For, although the process of disintegration is exceedingly slow, there is no evidence of the existence of a compensating influence on the earth by which these elements, by being built up from others, might be maintained at their present amount. Yet the periods are so very great that it is not to be wondered that these elements have persisted on earth so long. Compared with the lifetime of a man they may be almost exactly described as not changing at all.

Consider next uranium and its product, the body known as uranium X. The latter is easily separated from the former by simple chemical means. Let us consider a preparation of uranium from which the whole of the uranium X has recently been separated. Uranium disintegrates, and for every atom which disintegrates an atom of uranium X is produced. It is clear that, if uranium X were not radio-active, it must accumulate with time in the preparation of uranium. Actually, however, it is radio-active, disintegrating to form a third body; consequently it does not accumulate beyond a certain point, for there comes a time when the number of atoms of uranium X produced by the atoms of uranium is exactly that which disintegrates to form the third body. After that time has been reached the quantity of uranium X remains constant. The *quantity* remains constant, but the atoms comprising the material do not remain unchanged, for two things are happening. Some atoms are disintegrating to form the third body and as many others are taking their place from the disintegration of uranium. When this occurs uranium X is said to be in equilibrium with its parent uranium.

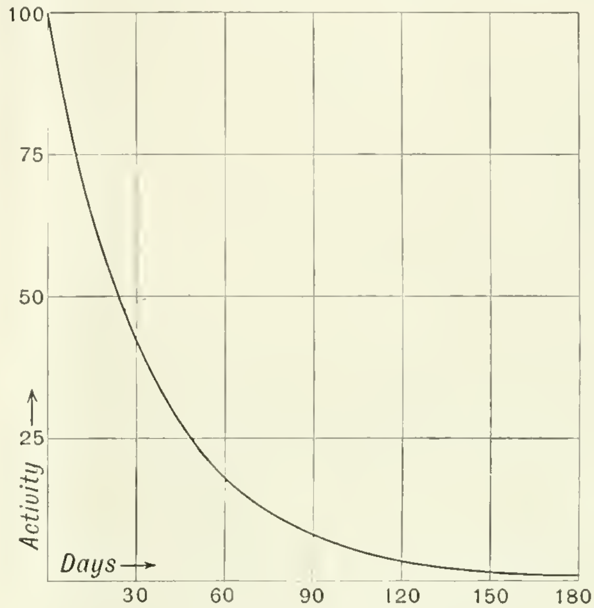

FIG. 1.—THE DECAY-CURVE OF URANIUM X.

These facts have an interesting consequence. If uranium X be completely separated from uranium it will disintegrate away according to the law that has been described above, but as fast as it disappears, when alone, it is grown from its parent uranium, the growth continuing until equilibrium is again reached. A few figures may make this clearer. Suppose 100 to represent the weight of uranium X in equilibrium with a given quantity of uranium. Then at the moment of separation of the former from the latter, which we shall call zero-time, the former preparation contains 100 units of uranium X, the latter none. The amounts found experimentally at subsequent times are set out in the table below:

Time in days.	Amount of uranium X in the uranium X preparation.	Amount of uranium X in the uranium preparation.
0	100	0
1	97·18	2·82
$24\frac{3}{5}$	50·0	50·0
$49\frac{1}{5}$	25·0	75·0
$73\frac{4}{5}$	12·5	87·5
$98\frac{2}{5}$	6·25	93·75
123	3·125	96·875
$147\frac{3}{5}$	1·562	98·438
$172\frac{1}{5}$	0·781	99·219
369	0·003	99·997

Note that there are always 100 units of uranium X in existence; whatever part is lost by disintegration of uranium X is made up by disintegration of uranium.

The curves obtained by plotting these two sets of results against the time are shown in Fig. 2, and are called decay- and rise-curves respectively.

A radio-element, therefore, appears to have a life only when it is away from its parent. Separate it from it and no power that is known can arrest or influence its rate of disintegration. But if it be with its parent, and equilibrium has been reached, the amount of it is constant, or it will only vary directly as does the amount of its parent. A product with its parent therefore appears to have the same life as its parent.

The fraction of the product that disintegrates per second has, however, a bearing on the matter. It cannot affect the *life* of the product when it is with its parent, but it does affect the *weight* of the product in equilibrium with a given weight of the parent. It is found that these weights are to one another in the same ratio as their half-value periods, and this result holds equally whether we consider a parent and its product or the parent and its product's product, or its product's product's product, etc. This is a very important and useful result. For example, the amount of uranium X in equilibrium with one kilogram of uranium is $\frac{24{\cdot}6 \times 1{,}000 \times 1{,}000}{5{,}000{,}000{,}000 \times 365}$ milligrams, since 24·6 *days* and 5,000,000,000 *years* are the periods of the two bodies respectively, and since there are 1,000 milligrams in a gram and 1,000 grams in a kilogram. This result when evaluated is 0·000013 milligram. So with radium, which is uranium X's product's product's product's product. The amount of radium in equilibrium with one kilogram of uranium may likewise be evaluated as 0·34 milligram. And so for other bodies. The longer the life of a radio-element the more there is of its weight in a preparation which contains the original parent. And the converse of this holds true also. In a mineral containing uranium and (as the majority of such minerals do) all its successive products, if the amount of pure uranium contained in it be determined, and the amount of radium be separated and determined, then if the period of uranium be known that of radium can be calculated, and *vice versa*.

There are about four principal methods of measur-

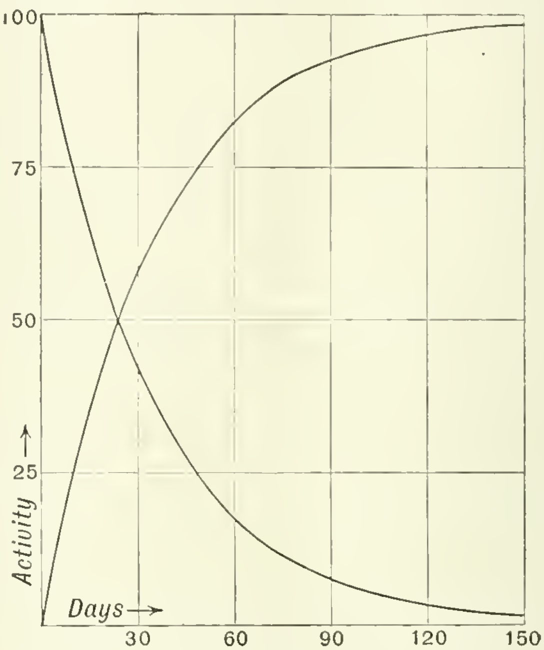

Fig. 2.—The decay- and rise-curves of uranium X.

ing the life of a radio-element, three of which may be described in outline. The first is to count the actual number of α-particles emitted each second by a known weight of the disintegrating material. Each α- particle that strikes a specially prepared screen gives a flash of light, and the number of flashes may be counted with a microscope by an observer in a dark room. In this way the number disintegrating may be obtained. Now the number of atoms in any given weight of this element is known. Divide the number of atoms that break up per second in a given weight by the total number of atoms in that weight, and the fraction disintegrating per second is obtained. In this way the period of radium may be measured.

A second method is to separate out and purify (if you can) and weigh the quantity of a radio-element

associated with a known quantity of the primary radio-element. If the weights of both and the period of one is known, then, as was mentioned above, the period of the other may be simply calculated. In this way the period of uranium has been obtained.

The commonest method, however, is to measure the radio-activity of a preparation at intervals in a special apparatus called an electroscope. From these observations it is not difficult to evaluate the half-value period or the period of average life. This is the chief method of measuring the periods of those bodies that lie between a few minutes and a few years, the majority of the radio-elements.

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Horse-Racing and Magic under the Roman Empire

By W. R. Halliday, B.A., B.Litt.
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AMONG the records of antiquity preserved in the great collections of Greek and Roman inscriptions there is a series of very human documents. The writing, with which they are covered, betrays as a rule their humble origin. They frequently contain mistakes of grammar and spelling, and the latter, upon occasion, throw an interesting light upon the pronunciation of their day. These documents consist of small sheets of lead inscribed with magical spells which have been inserted into graves or nailed to the walls of tombs.

Whether this practice was of oriental origin is not certainly known. It took firm root in Attica in the fourth century B.C., and spread thence with Athenian trade to Italy. The Romans adopted the superstition and carried it into the provinces of the West. In Roman Africa, the home of Apuleius (born about A.D. 125), the author of *The Golden Ass*, who was himself put upon trial upon the charge of magical practices, this, like all other magical arts, found a congenial soil. The African temperament, alike in literature, philosophy, and religion, was naturally inclined to exuberance and mysticism, an influence from which the Christian Fathers of African origin are not exempt. It is from this province that the document before us derives; it was found in the tomb of an imperial official near the site of Roman Carthage. It consists of a small sheet of lead roughly 5½ inches long; a series of cabalistic signs are inscribed round the borders, within which is written the Greek text.

The object of placing spells of this character in graves or of nailing them to the walls of tombs was to open up direct communication with the powers of the nether world. Sometimes the spirit of the dead man, whose grave is utilised, is itself compelled by the magic of the great names to carry out the terms of the spell. Another similar African inscription of the third century thus begins: "I conjure you, whoever you are, spirit of the dead man." A favourite place for the deposition of spells affecting the games was the *spoliarium*, or mortuary in which the dead bodies of gladiators were laid.

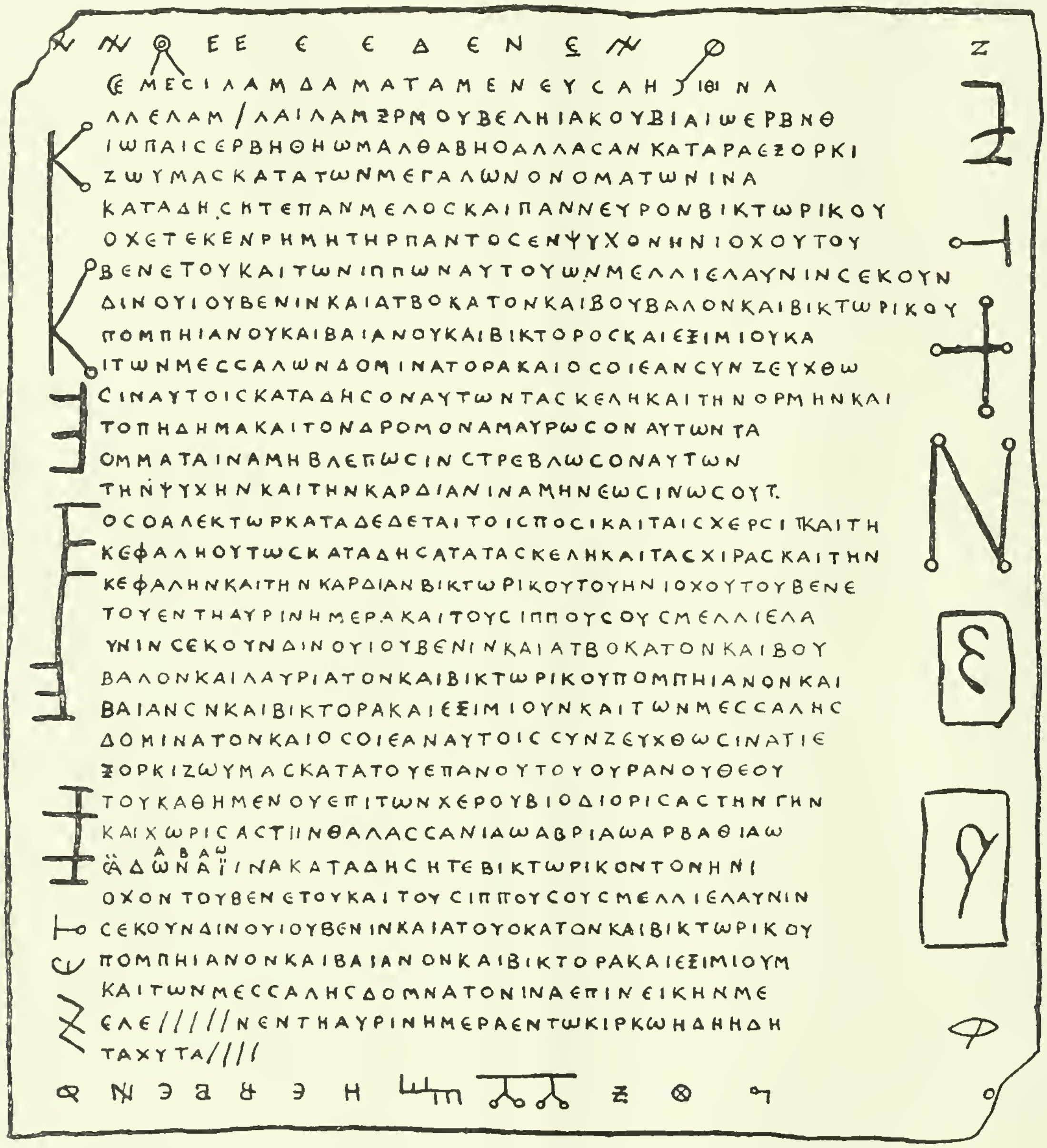
The inscription opens with a series of "words of power": *Semesilam damatameneus lesnnallelam·laikam ermoubele iakoub ia ioerbeth iopakerbeth eomalthabeth allasan.* Mystic words of invocation are a common feature of these conjurations. They are equally frequent in the magical papyri of the third and fourth centuries after Christ, and in the superstition of mediæval Europe. In magic a natural premium is set upon the strange and the unknown, which itself has an impressive because unintelligible sound, significance, or appearance. The general characteristics of such formulæ, whether they are found in the classical inscriptions or in the records of English folk-lore, are fairly uniform. Some are taken from foreign or strange religions. The magical inscriptions and papyri for this purpose drew largely upon the religions of the Jews and the Egyptians. Thus in the formula before us we have Ia and Iakoub; and forms of Iahwe and El, the two names of the Deity in the Old Testament, are favourites both by themselves and in their compounds. Thus another formula opens, Iao El Michael. Other formulæ consist of corruptions of names or words, e.g. the mediæval *hocus pocus*, which is an ignorant corruption of the words of the Mass, *hoc est corpus meum*, "this is my body." Of this kind is *damatameneus*, which appears to be a corrupt form of Damnameneus, who was one of the pygmy magicians (Idæan Dactyls) of ancient Greek folk-lore. Other formulæ, again, are simply arbitrary gibberish, sometimes an arrangement of mystic letters, as for instance a combination of the vowels which was very popular (e.g. *eueuiœeia oeianiuaieo*[1]) or sonorous nonsense words which often have an oriental or Egyptian looking termination in *beth* or *oth*. Compare, for example, the formula of an English charm against thieves quoted by Reginald Scot, which runs: "Drochs myroch esenaroth betu baroch ass maaroth."[2]

[1] In the magical papyrus discussed by Dieterich, *Eine Mithrasliturgie*, p. 4.

[2] Scot, *The Discovery of Witchcraft*, Booke XII, cap. 18.

"The spell. I conjure you by the great names that you bind every limb and every sinew of Victoricus, whom Earth the Mother of all living things bare, the Blue charioteer, and his horses which he is going to drive, Juvenis and Advocatus and Bubalus belonging to Secundinus, and Pompeianus and Baianus and Victor and Eximius belonging to Victoricus, and Dominatus belonging to the Messalas, and any others which may be harnessed with them."

The object of the spell is to prevent Victoricus, the charioteer of the Blues, winning the races in the circus. The passion for racing, which existed in imperial Rome, is notorious, and the provincial towns in this imitated the capital. There were four competitive factions or parties, whose colours were white, red, green, and blue. In the contests of their representative charioteers every individual was passionately interested. At the end of the first century after Christ, Martial, the poet, complains that, as a topic of conversation in polite society, literature cannot compete with the latest news of the betting upon Scorpus, a charioteer, who died when only twenty-seven, and is recorded to have earned in one hour fifteen purses of gold. According to Juvenal (the contemporary satirist), a charioteer of the Reds earned a salary roughly a hundred times that of the most successful barrister. Betting was heavy; but, apart



MAGICAL TABLET FROM A TOMB NEAR CARTHAGE.

from the money at stake, everyone was also a passionate partisan of his particular colour. Emperors themselves were known to abuse their power in the interests of their faction, and Caligula, an ardent Green, was accused of poisoning the horses of the Blues. "A party cry was supplied to the populace, which could not understand horses and racing, but could always rally to the meaningless colours. Nero or Marcus Aurelius might be master of the world, the Empire might be at peace or tottering in civil war and insurrection, the barbarians on the frontiers advancing or driven back ; at Rome for high or low, free or slave, men or women, Green and Blue was the one theme of anxiety and hope." [1] So intense was the rivalry that riots between the factions were frequent ; the most notorious are those which took place in the Circus of Constantinople in A.D. 552, in which 30,000 people were killed, and the Emperor Justinian but narrowly escaped the loss of his life and throne.

Returning to our text, the curious phrase after Victoricus' name is to be explained by magical usage. Individuals in these spells are invariably denoted by their mother's name, and not by a patronymic, because it was of the first importance that there should be no mistake as to the objective of the spell. " It is a wise child," says the proverb, " who knows his own father," but about the mother there can be no physical doubt. In this case, however, the author of the spell was evidently ignorant of the name of the mother of Victoricus, and was obliged, for formal completeness, to refer his ancestry to Earth, the mother of all things. The names of the horses and their owners are specified, and to provide for contingencies a general clause is added in case some other animal from the Blue stables is actually run. Horses were usually given " lucky " names indicative of desirable qualities or success. Thus in our list Juvenis suggests youthful vigour ; Advocatus, trusty help in time of need ; Bubalus, the swiftness of the gazelle ; and Eximius, excellence ; while Victor, Dominatus or Dominator, and Laureatus [2] (crowned with laurel) are associated with victory. It was a horse called Victor owned by a certain Gutta Calpurnianus, which held the amazing record of 429 victories in the circus at Rome. To have won a hundred races earned a horse the title of Centenarius and special trappings. The names Pompeianus and Baianus are connected with the horses' origin. The first may indicate that the horse was reared at the place Alba Pompeia, or possibly that it came from the stud of a man called Pompeius. Baianus probably refers to Baiæ near Syracuse. In the fifth century B.C., in the time of Æschylus and Herodotus, Sicily was already famous for its horses. Under the early Roman Empire enormous stud farms were developed in the island to meet the constant demands of the circus, and " when Gregory the Great was selling off the horses on the property of the Church in Sicily, a mere four hundred that were to be left seemed too inconsiderable to take into account." [3]

" Bind their legs and their motion and their leaping and their running, dull their eyes that they may not see, twist their souls and their heart that they may not breathe. As this cock is bound feet and hands (*sic*) and head, so bind the legs and hands and head and feet of Victoricus, the Blue charioteer, to-morrow and the horses which he is going to drive, Juvenis and Advocatus and Bubalus and Lauriatus belonging to Secundinus, and Pompeianus and Baianus and Victor and Eximius belonging to Victoricus, and Dominatus belonging to Messala and any others which may be harnessed with them."

The deposition of the spell was evidently accompanied by the magical binding of a cock, the object of which was to effect upon the familiar principle of sympathetic magic a similar " binding " of Victoricus and the horses. We may compare a passage in a Latin magical tablet which runs : " In the same way as I have twisted out and nailed down the tongue of this living cock, thus may the tongues of my enemies be silenced towards me." Narrative charms work upon the same principle of like causing like, the narrative taking the place of imitative action. Thus, headache may be driven away by reciting how Headache met Jesus upon the seashore, and Jesus ordered him to go off into the wilds and enter into the head of a bull.[4]

" Further, I conjure you by the god of the upper heaven, who is seated above the Cherubim, who hath put boundaries to the land and separated the sea, iao, abriao, arbathiao, adonaï sabao, that ye bind Victoricus the Blue charioteer and the horses which he intends to drive, Juvenis and Advocatus belonging to Secundinus, and Pompeianus and Baianus and Victor and Eximius belonging to Victoricus, and Dominatus belonging to Messala, that they may not arrive at victory to-morrow in the circus. Now ! Now ! Quickly ! Quickly ! "

The words of power here employed again show the use which the magic of late classical times made of Jewish religion and the Septuagint. *Adonaï* and *Sabaoth* are favourite divine names for such use throughout the Middle Ages. *Iao*, it will be noticed, is followed by arbitrary compounds without meaning—*abriao*, *arbathiao*.

[1] Friedländer, *Roman Life and Manners under the Early Empire*, vol, ii, p. 29.

[2] See below. The name is omitted by mistake in the first list of Blue horses.

[3] Friedländer, op. cit., p. 25.

[4] Pradel, *Griechische und Suditalienische Gebete, Beschwörungen und Rezepte des Mittelalters*, pp. 15–16.

The spell concludes like many of its class upon a note of urgency, and ends with what is a usual formula to compel the powers invoked to get at once to work. The rest of the story is lost. We do not know whether Victoricus and his horses were smitten in the night with mysterious illness, or whether the Blues won a victory upon the following day. The event, of such desperate moment to the writer of this spell, assumes across the ages its relative unimportance in the scheme of things. It is this vision of the futility of the immediate motives of human passion which lend these documents their pathos. In the almost untranslatable words of the poet Vergil, the greatest of those who have been accounted masters of magical lore,

"Sunt lacrimæ rerum et mentem mortalia tangunt."[1]

The sketch of the tablet is taken from *Corpus Inscriptionum Latinarum*, viii, 13511. A text and notes will be found in Wünsch, *Antike Fluchtafeln*, 2nd ed. (Bonn, 1912), pp. 9–13. *Inscriptiones Græcæ*, iii, 3, edited by the same scholar, contains a collection of all similar tablets which had been found in Attica and elsewhere before 1897.

[1] Vergil, *Æneid*, i, 462: "Tears are to human sorrows given, hearts feel for mankind." (Bowen.)

The Economic Position in Germany

By J. Ellis Barker

For many years the Germans have asserted that Germany was naturally one of the poorest countries in the world, that the extraordinary development of the national prosperity was due partly to the excellence of the German government, and partly to the industry and ability of the inhabitants. The statement that Germany is a poor country, though it was readily accepted abroad, is not in accordance with the facts. Germany, far from being naturally a poor country, is undoubtedly by far the wealthiest land in Europe. She enjoys great advantages for the pursuit of agriculture, commerce, and industry, although she has neither the genial climate of France and Italy nor the numerous harbours of England.

All North Germany is a level plain. One can travel from Cologne to the eastern frontier of Germany without passing through a single tunnel or important cutting. Level ground is ideal for the pursuit of agriculture. Moreover, Germany's soil is very fruitful, the climate is moderate, and the country does not suffer from the droughts which so frequently prove injurious in France and Italy. By the provision of nature, Germany produces an abundance of potash and other important chemical fertilisers.

The development of both agriculture and industry depends largely on an efficient and cheap transport system. Germany possesses the finest system of inland waterways in the world. The country is opened up by a number of deep and gently flowing rivers, which are navigable for very large boats for hundreds of miles, and they can easily be connected at comparatively small cost by lateral canals. The Rhine is navigable up to the Swiss frontier, and the Elbe up to the Danubian lands. As all North Germany is a level plain, railway construction was exceedingly cheap. The great success of the State railways was due not so much to the ability of the officials who managed them as to the fact that practically the whole of the Prussian State railways were built on a level plain, while the railways of France, England, Italy, and other countries had to overcome great natural difficulties.

Industrial prosperity depends nowadays on the possession of an abundance of cheap power with which machinery may be set in motion, and on an abundance of minerals required in industry. Previous to the war Germany possessed far more coal than all the other countries of Europe combined. Germany's coal is of excellent quality. It can be produced cheaply owing to the nature of the seams, and it is exceedingly rich in all those precious by-products which are more valuable than the fuel itself. In addition to an extraordinary wealth in coal, Germany possessed a superabundance of iron ore, zinc ore, and various salts, among which potash has attracted particular attention. About half of the country stands on a bed of salt. At some points bore holes have been sunk through 6,000 feet of solid salt without coming to the end of the deposit. With the continued progress of chemical science these salt deposits will prove of immeasurable value. Germany has vast stores of brown coal, or lignite, and of peat which can be made and are being made to yield cheap power, and the upper reaches of the rivers can produce millions of hydro-electrical horse-powers.

The development of commerce in a country depends on its productive capacity and on its geographical position. The German manufacturing industries and the German coalfields can furnish vast quantities of exportable goods. Moreover, commercial development is greatly promoted by Germany's central position in Europe and by her great rivers. Much of the land-locked and ice-locked trade of Russia goes habitually via the German harbours. Before the war a large part of Austria's foreign trade was carried by way of the Danube and of Hamburg, which was more important as a harbour to the Dual Monarchy than Trieste; and a large portion of the trade of Switzerand, Northern Italy, and Eastern France was carried by way of the

Rhine. By its geographical position, Germany occupies a situation comparable to that of Holland and Belgium in relation to Central Europe, or to Liverpool, Cardiff, and Bristol in the comparison with England.

The war has led to a serious reduction of Germany's area, population, and natural resources. The country has lost the bulk of its iron ore and of its zinc, and also vast quantities of coal and potash, to the victors. Still Germany remains by far the wealthiest country in Europe. She retains her level soil, excellent climate, her central situation in Europe, and her excellent inland waterways; and, notwithstanding the loss of Upper Silesia and of the Saar field, she retains her old pre-eminence as a coal owner among the European nations, as the following figures show:

—	Position in 1914.	Present Position.
	Tons.	Tons.
Germany	424,000,000,000	235,000,000,000
Great Britain	189,000,000,000	189,000,000,000
European Russia	60,000,000,000	57,000,000,000
France	18,000,000,000	31,000,000,000
Belgium	11,000,000,000	11,000,000,000
Holland	4,000,000,000	4,000,000,000
Poland	—	208,000,000,000
Other countries	78,000,000,000	49,000,000,000
	784,000,000,000	784,000,000,000

Germany has still considerably more coal than the United Kingdom, and the position of her coalfields is most favourable. The greater one lies on the Rhine and the lesser one in Upper Silesia. The manufacturing industries habitually settle about the coal pits. The Ruhr coalfield facilitates the coal export trade and industrial exports across the sea and towards Western and Central Europe, while the eastern coalfield is particularly well situated with regard to Russia, the East European countries and the Danubian lands. All the Continental countries, excepting Poland, remain comparatively poor in coal. The coal seams of France in particular are thin and exceedingly irregular, which means that French coal will remain scarce and dear if compared with German coal. Moreover, while Germany has most excellent coking coal, France has, both in her old coalfields and in the Saar measures, little coal suitable for iron smelting. Iron ore is habitually conveyed to the coalfields for smelting purposes. The iron ore of French Lorraine, Sweden, and other countries, will continue to be sent cheaply by waterways to the Ruhr coalfields to be smelted. Germany seems likely to retain her old pre-eminence in the iron and steel and engineering industries, as the following figures, taken from the *Iron Trade Review of Cleveland, Ohio*, show:

PIG IRON PRODUCTION

—	1913.	1920.	1921.
	Tons.	Tons.	Tons.
United States	30,600,000	36,401,000	16,750,000
Germany	19,000,000	6,500,000	7,500,000
Great Britain	10,260,000	8,007,000	2,700,000
France	5,126,000	3,275,000	3,200,000
Belgium	2,428,000	1,112,000	825,000
Luxemburg	420,000	685,000	960,000
Central Europe	2,343,000	870,000	965,000
Other countries	6,517,000	3,786,000	3,060,000
	76,694,000	60,636,000	35,960,000
STEEL PRODUCTION			
United States	31,300,000	42,100,000	20,100,000
Germany	18,631,000	8,000,000	9,000,000
Great Britain	7,664,000	9,057,000	3,700,000
France	4,614,000	2,915,000	2,900,000
Belgium	2,428,000	1,216,000	760,000
Luxemburg	918,000	590,000	760,000
Central Europe	2,584,000	1,225,000	1,500,000
Other countries	6,490,000	3,218,000	2,011,000
	74,629,000	68,321,000	40,731,000

Before the war Germany produced approximately as much iron and steel as all the other countries of Europe combined, and more than twice as much iron and steel as this country. In 1921 Germany's pre-eminence in Europe was very nearly as great as it was during the pre-war year.

The prosperity of the manufacturing industries in general, and of those industries in which coal is an important factor, such as the engineering industries, the chemical industries, earthenware, china, and glass works in particular, depends very largely upon the price of coal. In this respect Germany has an extraordinary advantage over Great Britain, France, and other countries in which coal is far more expensive than in Germany. Coal prices are fixed from time to time by the German Government. In December 1921 they were established as follows for the principal qualities:

	Marks per ton.
Mine run rich coal	405·10
Best mixed rich coal	455·00
Lumps rich coal	533·50
Nut rich coal, highest quality	545·50
Coking rich coal	413·20
Mine run gas coal	460·40
Nuts, gas coal, highest quality	545·50
Mine run meagre coal	401·20
Lumps, meagre coal	548·20
Best nuts, meagre coal	599·40
Best anthracite nuts	696·70

The prices given are inclusive of the German coal tax of 30 per cent., and the German tax on turnover. At the time when these prices were fixed, the German exchange was above M. 1,000 to the £. It follows that German coal was to be sold at about 10s. per ton at the pit's mouth.

The German industries have a great advantage over the industries of Great Britain and of other countries, not only owing to their being able to obtain excellent coal at prices which seem inconceivable over here, but also owing to the fact that wages are far lower in Germany than in this country, in the United States, in France, Switzerland, and elsewhere. Before the war a substantial day wage for hard-working men, such as a miner, was M. 5 in Germany, which then was equal to 5*s*. Now miners and other hard-working and well-paid men receive about M. 80 per day, which at the current rate of exchange is equivalent to about 2*s*. However, it should not be thought that German real wages have declined to less than half the pre-war rate. According to the statistics published by the German Government, living expenses have increased from 100 previous to the war to 1,397 in November 1921, when very high prices were reached. In other words, the cost of living had increased only fourteen-fold, although in November 1921 the cost of the pound sterling in German money had increased fully fifty-fold. While the cost of living had grown fourteen-fold by November 1921, wages had increased approximately sixteen-fold, as in the case of miners, whose earnings have been advanced from M. 5 to M. 80. There is a vast difference between the foreign and the internal value of the German mark.

The cost of living in Germany has been kept extremely low owing to the Government's policy. Large subsidies have been granted to cheapen food. The limitation of rents causes the workers to live practically rent-free, for a rent of M. 10 per week is equal only to a few pence in English money. Fares and freights are kept exceedingly low, because the State railways are run at a gigantic loss. Taxes, however and upon whomsoever imposed, are borne by the masses as a whole in the form of increased prices. Taxation is exceedingly low in Germany if compared with taxation in Great Britain. Germany's revenue from April 1, 1921, to the end of the year came to M. 51,665,295,000. At M. 750 to the £ that sum is equal to £75,000,000 in round figures, and the revenue for the whole year may come to M. 70,000,000,000, which would be equivalent to £105,000,000 at the rate mentioned, and to £140,000,000 at the exchange of 500 marks to the £.

German industry and commerce are prospering at the cost of Germany's finances. Between April 1 and December 31, 1921, Germany's national expenditure came to M. 132,360,574,000. Of this sum only M. 51,665,295 was covered by revenue, while M. 80,592,363,000 was found by increasing the floating debt of the country, which had rapidly risen to M. 246,921,550,000 at the end of last year. The floating debt consists partly of bank-notes and partly of treasury bills which are discounted with the banks and which must be renewed from time to time. The stock of bank-notes in circulation has increased as follows since pre-war times:

	Marks.
June 10, 1914	2,407,000,000
December 31, 1914	5,046,000,000
,, 1915	6,918,000,000
,, 1916	8,055,000,000
,, 1917	11,468,000,000
,, 1918	22,188,000,000
,, 1919	35,698,000,000
,, 1920	68,805,000,000
,, 1921	113,639,000,000

We cannot wonder that the value of the mark has declined very severely in view of the gigantic increase of the bank-notes in circulation. There is considerable danger that, at some time or other, the banks, alarmed by the financial recklessness of the Government, may refuse re-discounting the treasury bills which fall due. In that case the Government would have to repay the banks in cash, which means in bank-notes. The note printing press would be set in motion with the utmost energy, and the consequence might be the complete collapse of the German currency. It is significant that the great increase in the note circulation took place, not during the war, but after its conclusion.

The new men who came into power in consequence of the revolution tried to make themselves and the new régime popular by increasing wages and salaries, granting subsidies and doles, and keeping taxation low. They endeavoured to create an atmosphere of prosperity by means of the printing press, and by running more and more deeply into debt. The régime of inflation has been fatal to all who live on fixed incomes. Many of those who formerly were rich or well-to-do have been utterly ruined. Also the cash savings of millions of thrifty men and women deposited in the savings banks or placed in small bonds have been reduced to a trifle. Naturally millions of thrifty and conservative men have been embittered by the robbery practised upon them, and among the most conservative people a spirit has been raised which at some time or other may prove exceedingly dangerous to the democratic form of government in Germany. The dilution of the currency has enriched all the debtors by reducing their debts to a mere fraction. It has transferred millions from the thrifty to the thriftless.

The inflation of the currency has created a gambling mania throughout Germany, and has led to the most reckless speculation, which is the usual result of currency dilution. All business has become a gamble. An ordinary commercial transaction may result in a huge unexpected profit owing to a sudden change in the value of the currency, or may bring about a ruinous unexpected loss. Gambling in foreign exchange, in stock exchange securities, in land and houses, and in goods of every kind has taken unprecedented pro-

portions. Banks and stockbrokers are overwhelmed with speculative business, and two important provincial banks have been ruined by illegitimate exchange speculation undertaken by their officials. A veritable orgy has taken place in the field of company promotion. In 1913 shares of the nominal vaule of M. 635,000,000 were issued in Germany. In 1921 share issues came to M. 19,229,000,000, or were more than thirty times as large as during the pre-war year. In 1916 the share capital of all the German companies came to M. 16,000,000,000, in 1919 it stood at M. 20,300,000,000, in 1920 it reached M. 29,000,000,000, and in 1921 it arrived at M. 54,700,000,000. Many companies have doubled, trebled, and quadrupled their capital.

Germany's post-war prosperity has been built up on the treacherous basis of unsound finance. Inflation is always followed by deflation. Every boom leads to a slump, and the wilder the advance has been, the more terrible will be the crash. England and the United States have suffered severely from the reaction which followed a relatively unimportant currency inflation and boom. The unparalleled expansion of business in Germany and the extraordinary advance in prices are bound to be followed by an unparalleled crash and ruin. Meanwhile Germany seems highly prosperous. In 1913 there were 9,725 bankruptcies in Germany, and in 1921 there were only 2,975.

The tremendous advances in stock exchange quotations and the extraordinary activity of the industries in Germany are largely due to the depreciation of money. Fearing the continued decline of the value of money, and wishing to anticipate a corresponding rise in prices, most Germans are trying to convert their money into more reliable values. People of means buy land, houses, and stock exchange securities, while poor people clear the shops of their contents, and buy boots and clothes for years ahead. The prosperity of the German industries is rather due to the frantic home demand than to the expansion of the export trade.

A crash is bound to follow the present mania. However, such an event will not destroy the great physical and human resources which form the foundation of Germany's wealth. The Government endeavours to strengthen the wealth-creating factors of the country to the best of its ability. The railway system is rapidly being enlarged and improved. Numerous electric power stations are being created. Vast inland waterways are being constructed ; among the latter is a deep canal which will connect the Rhine with the Danube and which will cost more than M. 2,000,000,000. When the reconstruction of Russia is taken in hand, Germany will probably obtain by far the largest share. Hundreds of thousands of Germans know Russian, and hundreds of thousands of Russian emigrants are living in Germany and are becoming Germanised. The Germans love work. They are naturally painstaking and progressive, and "ca'canny" is unknown to them. Owing to these factors Germany should rapidly recover, provided she enjoys peace and political stability.

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The Renascence of the English Short Story—II

By Thomas Moult

In America the storyette of the mechanicians has reached a level of skill that is often hard to distinguish from original talent. The English average has seemed to sink lower and lower every year. The short-story writers who have taken any artistic pride in their work during this score of years can be almost counted on one's fingers, nor has their work, with one or two exceptions, been found as a regular feature of the popular magazines. Of this handful of writers, some are still working, and working well ; and they have been recruited by a group of younger artists who, even more than their older fellows, have regarded the short story as a pursuit in itself, and by no means a side-issue of their more serious activities in literature. Some of these are inclined to the old-fashioned and some to the newer methods. In what proportions they may be classified is a point of no importance compared with the fact that, new or old, the practitioners of the present are at one in recognising the infinite possibilities of the *genre* as it is now regarded by all who have been forced to consider it elastic and no longer confined to boundaries. The short story, in a word, is being discovered afresh.

Leonard Merrick and Stacy Aumonier, for example, with a slight bias to the story of plot, are each in their own unique way contributing something suggestive and tentative to the art. Their work centres still in a single incident, clear-cut and roundly defined from the first word to the last. Stacy Aumonier may almost be said to attempt in England what O. Henry just failed to do in America—to make the anecdote something more than an anecdote. Merrick, with an ironical finesse and delicacy that are all his own, has made Henry Murger's Bohemian life, in its modern aspect, look exactly as our matter-of-fact age desires to see it. " 'I am very pleased to meet you,' he said with disgust "—that is a typical line from Merrick's writings that seems to make plain the whole outlook of its in-

ventor. Again, the late Jack London, by taking the technique of Conrad and Kipling and trekking back to the primitive, has written stories which exploit the element of the unexpected in the mental as well as the physical nature of his characters with a success that here and there equals that of the early Wells.

But these, although they are to be ranked among the "re-discoverers," who have kept some of the older traditions, cannot be regarded as of anything like the importance they would gain if they were adventurers as well. There is another group of short-story writers who have been profoundly impressed by the researches of psychology, and who are now desiring to exploit the possibilities which the literature of Russia promised for the writer who takes those researches into account.

It must be confessed that the adventure which confronts them as a consequence of this is rather foolish and foolhardy. The battle, as they see it, is not between the old type of story and the new; but between the intellectual and the imaginative. It is, however, given to few authors to serve equably the two masters, imagination and intellect; and imagination is certainly at a premium among those who are now endeavouring to reconcile the demand of what is, after all, an intensely *imaginative* art-form with the demand of modern science. Whatever may be the faults of the conventionalists in short-story writing, they did, and do still, preserve some sort of proportion. Often while reading the stories of Katherine Mansfield (and to Miss Mansfield's credit, as to that of Miss May Sinclair among the older writers, we place some of the finest short stories of the episodic type written in recent years), we are disturbed by the feeling that she has absorbed the influence of the Russians not only in style and method, but also in her own imaginative revelation. We seem to be acquainting ourselves in this same writer's work with Tchekov [1] over again, severely intellectualised; not with one who has sat at his feet and come away something more than a disciple.

[1] Anton Tchekov, the greatest and most original short-story writer of modern times, was born in South Russia in 1860, and died in 1904. Just as he never tries to give the whole history of his characters from their birth to the grave in a single tale, so he never attempts the anecdote—he prefers to that the kind of story in which nothing happens at all. The supreme expression of his gift, however, is in those stories where light has been focussed for a brief catastrophic moment upon one or two main personages. In the hazy outlines which, as Kropotkin, a well-known Russian literary critic, has said, you rather guess than see, a world of complicated human relations gradually comes to focus. Take away either the distinctness or the haziness, and the picture is spoiled. Sixty of these stories have been translated by Constance Garnett and published in the Saint Martin's Library in a series of volumes not yet completed (Chatto & Windus, 3*s*. 6*d*. net each).

As with Tchekov, everything she does is self-revealing. In *Bliss, and Other Stories*, her recent volume, there are some remarkable lines concerning a tree, which may be quoted here to indicate the distance which lies between the conventional and the newer expression in the short-story form; they are lines which at one time would have been considered outside the province of an art that demands the sternest economy:—

"It was then that he saw the tree, that he was conscious of its presence just inside a garden gate. It was an immense tree, with a round, thick silver stem and a great arc of copper leaves that gave back the light and yet were sombre. There was something beyond the tree—a whiteness, a softness, an opaque mass, half-hidden—with delicate pillars. As he looked at the tree he felt his breathing die away, and he became part of the silence. It seemed to glow, it seemed to expand in the quivering heat until the great carved leaves hid the sky, and yet it was motionless. . . . Deep, deep he sank into the silence, staring at the trees and waiting for the voice that came floating, falling, until he felt himself enfolded."

This ability to extract new meaning and added beauty from our life and our surroundings is one of Katherine Mansfield's triumphs. In the above passage she is very near to her master, and yet very nearly herself, very nearly an innovator.

J. D. Beresford, whose *Signs and Wonders* and his earlier collection contain stories entirely plotless and passionless, and are of a mordant quality on the few occasions when plot and passion are present, seems to lack nothing that makes a good story of the episodic type; and yet, the kindling fire being absent, we do not look with the same confidence for some new contribution to the art as we may look to Katherine Mansfield. Two other writers are working eagerly towards that hidden future. A. E. Coppard exploits in his first book, *Adam and Eve and Pinch Me*, a clever technique and a sprightly and versatile humour that make us unconcerned how much he owes to the Russians and how much to the Irish revival—as a matter of plain truth, he owes a good deal to both. In him the intellectual quality never tips the scales quite so decidedly against the imagination. Nor does he take himself too seriously, like J. D. Beresford, nor hold himself too cheaply, like the other of the two young writers, Aldous Huxley, the author of *Limbo*. In reading A. E. Coppard's stories we feel that he has approached his work with an attitude almost as childlike, as naïve, as that of the late Padraic Pearse. And this is to his advantage, let it be added, for Pearse's untimely end, during the Dublin rebellion of 1916, will not deprive him of our recognition for his charming and original gifts as a short-story writer that rank him, with Synge, among the leading artists of his land.

It is reasonable, in summing up, and taking all these new tendencies into account, to assume that the present activity in short-story writing is not simply of experiment, but of discovery. No longer is it necessary to abide by the dogmas of twenty years ago, nor by the dogmas of the subsequent revolt. New possibilities are being realised, and just as in our own time we have witnessed a definite change in the characteristics of the novel, so for the immediate future is promised a new type of short story, a blend of all the better qualities that have appeared in its career and persisted. What that new type will eventually prove to be is a matter for everyone's speculation, although if we looked for a precursor we might find it in at least one of the older examples—that, say, by Charles Dickens, called *A Child's Dream of a Star*. In sympathetic revelation through plot and emotional analysis of the one transcendent longing of the soul, this story is surely a portent. "He grew to be a young man; and the star was shining." . . . "He grew to be an old man; and the star was shining." The refrain haunts the reader. "And the star was still shining; and it shines above his grave." It is certain that Rudyard Kipling and Henry James will no longer be antagonists in method, which must be dovetailed and amplified into something that for once will overstep the old boundaries of what has proved itself a fascinating and fruitful art.

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An excellent small anthology of English short stories has recently been compiled and edited by Dr. Hugh Walker and Mr. H. S. Milford, entitled *Selected English Short Stories*: Vol. I, *Nineteenth Century*; Vol. II, *Twentieth Century*. (The World's Classics. Humphrey Milford, Oxford University Press, 2s. each.)

Reviews of Books

THE ORIGIN AND DEVELOPMENT OF OUR CALENDAR

The Calendar: Its History, Structure, and Improvement. By Alexander Philip, LL.B., F.R.S. Edin. (Cambridge University Press, 7s. 6d.)

The Beginning of the Year in the Middle Ages. By Reginald L. Poole. (From the *Proceedings of the British Academy*, vol. x.) (H. Milford, Oxford University Press, for the British Academy, 3s.)

The scope of Mr. Philip's book is not so wide as his title might be taken to indicate. His main preoccupation is our own system, and primitive methods of time-reckoning do not come within his purview, while ancient calendars and the Chinese, Indian, Mexican, and Mohammedan systems are little more than mentioned incidentally. In other words, his history of the calendar starts at that point at which the approximate length of the year has been fixed, and an attempt has already been made to correct the approximation and bring it into accord with observed facts. The difficulty arises out of the lack of correspondence in periodicity in the natural time measurements, the day, the month or period of the phases of the moon, and the year. The various forms of calendar attempt to correct this discrepancy by intercalation, the insertion of one or more additional days at certain intervals, as our own calendar inserts one day at the leap years.

In its origin the calendar is essentially connected with seasonal activities and, in particular, with those of agriculture. The Egyptian calendar, owing to the length of time over which we can watch it in operation, affords a highly instructive example of this seasonal relation, as well as of the consequences of error. The annual event of fundamental importance in the life of the Egyptians, and the one of which it was necessary that the date should be known beforehand with approximate accuracy, was the rising of the Nile. The Calendar of Lucky and Unlucky Days indicates that originally the year consisted of 360 days, divided into twelve months each of 30 days. To this year of 360 days, five days were added. According to one system of dating, this took place as early as 4241 B.C.; in any case this "vague" year, as it was called, was in common use by 3000 B.C. This year, being approximately $\frac{1}{4}$ day short, failed to correspond with the natural year by one day in every four years, and in 1461 "vague" years had moved completely round the year. The discrepancy in the date of the inundation led to the institution of the Sothic year of 365$\frac{1}{4}$ days, which started with the heliacal rising of the star Sept (Sothis or Sirius) about July 19 or 20, when the Nile flood usually began. The Roman year originally had ten months, to which number Numa is said to have added two, making a year of 355 days, with an intercalation which took place either every eight, or two, years. Owing to this system of intercalation, which, with subsequent further intercalations, was in the hands of the Pontifices (or Priests), there was great confusion and uncertainty in regard to

the important dates of the year, until its reform was taken in hand by Julius Cæsar. The Julian calendar differed from its predecessor in that, instead of attempting to reconcile the lunar months with a solar year, it abandoned the lunar months and fixed the months without reference to the phases of the moon. The year was made to consist of 365¼ days with an intercalation every four years of one day. The 365¼ days were divided up into twelve monthly periods, each consisting of 30 or 31 days, excepting in the case of February.

The Julian year, like the Egyptian year, being 11 minutes and 14 seconds longer than the natural year, gave rise to a discrepancy, chiefly noticed in connection with Easter, which, when Gregory became Pope in 1572, aggregated ten days. By the Bull of 1582, ten days were dropped from the calendar, and it was provided that out of every four centurial years only those exactly divisible by 400, such as 1600, should be retained as leap years. This reform was adopted at different times by different countries. In this country it did not come into force until 1752, by which time the discrepancy had increased to 11 days, the reform giving rise to the popular cry of, "Give us back our eleven days." The Gregorian calendar has only recently been adopted in those countries which belong to the Greek Church.

There are a number of important points raised by Mr. Philip's historical survey which invite consideration, did space allow. One point of great interest is the week, and the relation of the Jewish week of seven days to the week used by the Nordic peoples, which clearly was a five-day week. Mr. Philip does not enter into the question of the origin of this arbitrary division of time. While the Jewish week is based upon the recurrence of the rest day, the origin of the Nordic five-day week is obscure. Among primitive peoples the week, which in West Africa, for instance, consists of four or five days, is often based upon the recurrence of a market.

The chief defects in our calendar to which Mr. Philip points are due to the constant fluctuation in the relation between the month-day and the week-day. As a remedy he suggests the transfer of one day from August to February. In order to establish a perpetual correspondence between month-day and week-day, the odd day annually and the odd day in leap year, it is suggested, should be excluded from numeration as days of the week. Mr. Philip's suggestion has the merit of simplicity and entails a minimum of dislocation. In so far it appears less objectionable than many of the other proposals which have been brought forward, such as the suggestion of a year of 13 months of 28 days each.

Mr. Reginald Poole's communication to the British Academy deals with a difficulty, of the greatest practical importance to historians, arising out of methods of reckoning the beginning of the year under different systems. Under the Julian calendar the year began on January 1, but before the institution of the Julian system, the Roman year began on March 1. The Franks also began their year on March 1, and Mr. Poole thinks it possible that this may have been connected with Roman military service, for which purpose the use of the older date was retained. The established usage in Western Europe up to the eleventh century was that the year began at Christmas, except in Spain, where up till the fourteenth and fifteenth centuries the year began on January 1. Generally, however, January 1 was regarded with aversion on account of its pagan associations. At about the eleventh and twelfth centuries Christmas began to be superseded by March 25, and this continued to be the official mode of reckoning in this country down to 1752. In addition, there was the Byzantine year, which began on September 1, the year reckoned from the Annunciation, nine months *before* Christmas, known as the *calculus Pisanus*, and finally a system which reckoned the year as from Easter. As a consequence, and owing to the fact that chroniclers, assuming that their system of dating is familiar to their readers, do not make clear what method has been followed, it is often extremely difficult to decide in which of two years an event is to be placed. Mr. Poole, by sifting the evidence for the chronological order of the appearance of the various systems and their geographical distribution, has done much to elucidate a very difficult problem, and his results will be of the highest value to the student and the historian.

E. N. Fallaize.

[For further reading on this subject see article on *The Roman Calendar* by Prof. W. R. Halliday, Discovery, Vol. II, No. 21, p. 238.—Ed.]

SOME BOOKS ON PSYCHOLOGY

The Psychology of Society. By Morris Ginsberg, M.A. (Methuen & Co., Ltd., 5s.)

The study of man's behaviour as the member of a community is almost as old as civilisation, but the subject has been approached almost exclusively in the light of preconceived theories of human conduct, and only of recent years has the attempt been made to discover "the general principles of group life and their application to particular kinds and examples of groups," and thereby to place the study of social psychology on a scientific basis.

But in a new science, especially where the data are difficult to observe and impossible to measure, the explanatory theories are bound to be tentative, and to some extent divergent, so that Mr. Ginsberg's book serves a useful purpose in reviewing and submitting them to detailed criticism. The author finds that for the most part the theories of social psychology are inadequate to the complexity of the subject, a finding that may be stimulating to the student or specialist, but likely to prove discouraging to the general reader, for whom, however, the book is probably not designed, since it presupposes a considerable acquaintance with contemporary psychology.

Prof. MacDougall's theory of instincts, in which the basis of all human activity is sought for in a group of primitive instincts common to man and the higher animals, is criticised especially for its inadequacy to explain satisfactorily the disinterested motives of conduct.

Similar criticism is directed against Prof. MacDougall's conception of a group mind as an entity transcending the individual minds of which the group is composed, a conception in which the author detects a conservative and aristocratic bias since, he says, the group mind cannot speak for itself, but is "apparently only interpreted by the 'best' minds of the community," and the idea of its superiority tends to further the preservation of a *status quo*.

The modern reaction against reason and the complementary importance given to impulse and intuition is criticised as an attempt to isolate reason artificially as a faculty separate from sense and impulse, and as a failure to regard the self-conscious personality as a whole.

The book ends with a chapter on organisation and democracy, in which a somewhat pessimistic view is taken of the possibility of true representative government by the people.

F. A. H.

The Psychology of Thought and Feeling. By Charles Platt, Ph.D., M.D. (Kegan Paul, Trench, Trübner & Co., Ltd., *7s. 6d.*)

Dr. Platt has attempted the difficult task of giving a "fairly reasonably complete survey of the whole field of psychology"; but the field is a large one, and much of the territory not very definitely mapped, so that the author, in order to be comprehensive and at the same time easily read, has been compelled to make the subject appear a good deal more simple than his readers are likely to find it on closer acquaintance. For instance, some of the chapters that contain detailed instructions for improving the memory or fairly easy generalisations about education rather suggest that they fill in gaps that would otherwise be occupied by somewhat difficult aspects of the subject. The first part of the book is mainly an exposition of Prof. MacDougall's Social Psychology; the latter part of the book deals clearly and vigorously with the "subconscious mind," and as completely as is consistent with the omission of what is controversial, proceeding to a discussion of mysticism, telepathy, and spiritualism.

Dr. Platt believes in the theory of spiritualism on the grounds of its intrinsic acceptability to the human mind, for he does not consider that it is "based on any scientific foundation," and he appears to reject the so-called "spiritistic" phenomena as evidence of external agency.

A short account is given of Freud's earliest theory of the causation and treatment of the neuroses, which is clearly dealt with and is accepted by the author, although he does not subscribe to the generalisations of the Freudian school of psychology.

The volume ends with a chapter on "the delinquent," in which a well-justified plea is made for the consideration of the criminal either as a psychopath or as a potentially good citizen who is the victim of his environment, in any case as an individual to be segregated, rather than punished to vindicate the rights of society.

The substance of the book was delivered as a series of popular lectures in America, an origin that probably accounts for the rather dogmatic and sometimes colloquial style that is especially marked in the earlier portion.

F. A. H.

The Beloved Ego. By Dr. W. Stekel. (Kegan Paul, Trench, Trübner & Co., Ltd., *6s. 6d.*)

This book was the first introduction of its author to the English-speaking public, and it will be welcomed by all those interested in analytical psychology. It is popular in character and more readable than many novels. It differs from all previous books of the kind in being the work of a poet who is also a man of science, and the literary style as well as the insight show unmistakable traces of the poet's vision. In Dr. Stekel's preface to the English edition he tells us that one of his "first and best teachers of Psychology was an Englishman—Shakespeare, now in the Heaven of the Immortals."

The book consists of nineteen sketches, the first one dealing with the subject of the book, "The Beloved Ego." In this chapter Dr. Stekel plumbs the depths of our self-love. According to him we are born egoists, and the whole education of life consists in a progression from egoism to altruism. The nature of love is analysed. We like a person who holds "our" views, a picture, when seen with "our" eyes, a poem, when it gives expression to "our" mood. And that girl pleases us who has our own traits. "We see a being who is as we would wish to be ourselves." There is an ironic touch in the description of flocks of people at the seaside or in city parks, "who are only really happy when they can show themselves for hours to their fellow men and women." The "popular sun baths are baths of self-love, and would never be taken at all if the bathers were isolated from each other." The Beloved Ego sometimes works through underestimation of self, "because all life appears in a double form (the law of bi-polarity)." These egoists are tortured by their own inferiority, they cannot trust themselves, they are what one might call inverted egoists. Dr. Stekel finds the whole world interpenetrated by our Ego-rays. "We find a person unsympathetic if he brings before our eyes our own bad qualities in caricature. We hate anyone when he personifies an unpleasant part of our soul." The chapter ends on a note of hope: "We see nothing but ego-rays which are at war with each other, an eternal chaos out of which will eventually be born the eagerly desired world of altruism."

Closely allied to self-love is the "will to power." Dr. Stekel sees in this the root cause of the fight of the sexes, which extends from marriage into social life, and comes to rich fruitage in many "neurotics who shrink from every love as from one which might put them in bonds, because they are afraid of the domination of one outside themselves."

In the remaining chapters we are introduced to characters well known to all of us. There are the "Half-Men," such as the "half-artist, half business-man"; the "half-pious, half-atheist"; the "half Don-Juan, and half-philistine." These dissociated personalities split themselves up in different endeavours, and bring nothing

to completion. Dr. Stekel sums up the whole evil of the time in the term, " Half-Men."

Next we meet the " Doubter," and find that the doubt or fear is always of himself. The true believer in himself is never in doubt. " All strong belief disinfects the soul, and kills the destructive germs of doubt. The doubter knows no true belief." He courts the " situations where his doubt can have free reign." He doubts everything, " finally also his own doubt."

The next picture in Dr. Stekel's portrait gallery is that of the smoker of psychic opium, or, in other words, the day-dreamer, both conscious and unconscious. The poppy of phantasy unfits these people for life, and they, therefore, create worlds of their own in which they garb themselves in royal purple. Reality of all kinds excites their contempt.

" Fear of Joy," " Envy," " Impatience," all have chapters to themselves, and then follows " The Unlucky Dog." It might be thought at first sight that he at least could hardly worship the Beloved Ego. But yes, Dr. Stekel shows up the " Unlucky Dog " as a supreme egoist. His ill-luck is his strong card. No one is as unlucky as he, and he reigns supreme in the kingdom of ill-luck. Back of it all is his thirst for love. " He is a beggar for love and rarely begs in vain." " As he cannot obtain the gold of love, he puts up with the copper of compassion." He gains pleasure from pain. He believes not only in his own bad luck, but that he brings bad luck to those associated with him, and thus secures the supremacy of his own ego. Dr. Stekel concludes his book by a number of Aphorisms.

J. C.

AN ANCIENT EGYPTIAN CEMETERY

Balabish, being the thirty-seventh Memoir of the Egypt Exploration Society. By G. A. WAINWRIGHT, with a Preface by T. WHITTEMORE; 25 plates and several figures in text. (George Allen & Unwin, Ltd., 42*s*.)

This volume is in theory merely the record of the excavation of the cemetery of Balabish in Upper Egypt in 1915. In point of fact it is considerably more than this. Mr. Wainwright is not content merely to present to his readers the material which he has found; he sets out to interpret it by ascertaining its place in the series to which it belongs. The cemetery is a particularly interesting one, for a large portion of it belongs to the so-called pan-grave[1] culture, which all authorities agree in attributing to small bodies of Nubians who intruded into Egypt during the Later Intermediate Period. Mr. Wainwright's study takes us considerably further than any previous work on the subject. His method is the detailed comparison of the objects actually found at Balabish with those found in similar cemeteries elsewhere, a method with which his work on Keftiu[2] has made us familiar. His first conclusion is that the pan-graves of Egypt proper have certain affinities with the later graves of the Nubian[3] C-group, but differ very seriously from the earlier. While agreeing with the result, and in general with the method by which it is reached, we are inclined to think that, when two cultures are being compared, the absence from the one of a rare object which occurs only once or twice in the other should not be used as an argument for difference, though, of course, the presence of a rare object (such as the net-bag of elephant's hair) in both would be strong presumptive evidence of connection. In other words, this type of argument has some value when used positively, but none when used negatively.

Mr. Wainwright next refers to the civilisation lately discovered by Reisner at Kerma, in the Sudan. He points out that not only has it features which distinguish it from the C-group culture of Nubia, but that the few examples of it found in Egypt proper are quite distinct from the ordinary pan-graves This civilisation is mainly marked by the occurrence of a beautiful thin red pottery with black top and intermediate band of grey, the commonest shape of which is the inverted bell-shaped cup with out-curving rim. To the list given of these vases found in Egypt may be added several perfect examples found by Garstang in 1907 at Abydos, in a tomb with two loosely contracted bodies laid on the left side. It is perhaps early to decide whether these vases belong to a special civilisation, or whether they are merely the finer specimens of the art of the potters of the C-group people; in the meantime, Mr. Wainwright is certainly wise to keep the two apart.

The New Empire[4] graves of the Balabish cemetery are less important, though Mr. Wainwright has invested them with interest by a minute inquiry into the origin of the foreign pottery which they contain. It is to be wished that he could find time, despite the troubles of an Inspector's life in Egypt, to extend this examination to cover the whole field of Egyptian imported pottery, beginning with the probably foreign jugs from the tomb

[1] Pan-graves is the name given by their first discoverer to certain shallow tombs scooped in the surface sand in various parts of Egypt, and containing the bodies of persons clearly not Egyptians, accompanied by objects partly of Nubian manufacture. The resemblance of these graves to pans is, it must be admitted, by no means striking. The Later Intermediate Period covers the years 1800–1600 B.C.

[2] Keftiu was until lately believed to be the Egyptian name for the island of Crete. Mr. Wainwright's researches have established a very strong probability that it was in reality Eastern Cilicia.

[3] The remains of the early prehistoric period in Nubia have been divided chronologically into three groups, A, B, and C. The A group corresponds in time to the Predynastic and Early Dynastic Periods in Egypt (about 3500–2800 B.C.). The B group extends into the interval between the Sixth and Twelfth Egyptian Dynasties, while the C group, marked in Nubia by a very flourishing and totally non-Egyptian culture, covers the Twelfth Dynasty (2000–1800 B.C.) and extends into the Later Intermediate Period which separates this from the Eighteenth.

[4] The New Empire or New Kingdom is the name given to the period of the Eighteenth to Twentieth Dynasties (1580–1200 B.C.), the Middle Kingdom being the Twelfth, the Old Kingdom the Fourth to Sixth, and the Archaic Period the First to Third. The missing dynasties form the Earlier and Later Intermediate Periods.

of King Zer [1] and the very doubtfully "imported" pots of the predynastic period. We should all probaby lose some of our cherished illusions.

We have nothing but praise for the book. The general discussion and the masses of references show what care and affection the author has devoted to his subject. The plates are excellent.

T. E. P.

SHORTER NOTICES

A Star Atlas and Telescopic Handbook. By ARTHUR P NORTON, B.A. (Gall & Inglis, Edinburgh, 10*s.* 6*d.*)

Astronomical Photography for Amateurs. By H. H. WATERS. (Gall & Inglis, 6*s.*)

The atlas is intended for people described as "amateur telescopists." It covers the whole Star sphere, and shows over seven thousand stars, nebulae and clusters. The maps are drawn for the epoch 1920. It should be a useful guide to the night sky.

The second book is a handbook for beginners, for those who are neither great astronomers nor great photographers, which will enable them to make the best use of the apparatus at their disposal in photographing the heavenly bodies.

Edinburgh's Place in Scientific Progress. Edited by C. G. Knott, D.S.c, F.R.S. (Chambers, 6*s.* 6*d.*)

In praise of the great men of the different sciences who have worked and received inspiration in Edinburgh. The work accomplished in each science is described by a separate living authority on it; the whole edited by Dr. Cargill Knott. The joint-authors give an interesting story of Edinburgh's contribution to Science without attempting to prove that all light and learning emanated from within the four-miles radius from Prince's Street.

The Seven Ages of Childhood. By ELLEN LYMAN CABOT. (Kegan Paul, Trench, Trübner & Co., Ltd., 12*s.* 6*d.*)

Mrs. Cabot's book is not so much a study of childhood as a description, written with great sympathy and often lyrical enthusiasm, of the doings and feelings of American children. The seven ages into which the author divides childhood are the dependent, dramatic, angular, and paradoxical age, and the age of the gang, of romance, and of problems, but some of these ages seem to be coexistent phases rather than successive stages of development.

The characteristics of each "age" are illustrated by a wealth of description and quotations from letters and conversation, but there is little or no attempt to seek for what may lie behind these changes of temperament and behaviour.

The Psychology of Medicine. By T. W. MITCHELL, M.D. (Methuen & Co., Ltd., 6*s.*)

Dr. Mitchell's clearly and carefully written outline of recent developments in psycho-therapeutics, and in particular of the growth and scope of psycho-analysis, is recommended to those who, though they have had no professional training in Medicine or Psychology, are desirous to read a concise general account of these new departments of knowledge.

Literature and Life. By E. B. OSBORN. (Methuen & Co., Ltd., 7*s.* 6*d.*)

Mr. Osborn is the literary editor of the *Morning Post.* It must be admitted that we opened his book expecting to find a much-needed treatise on literature as an interpreter of and influence upon life, and that we were momentarily disappointed. Only momentarily, though. We soon found ourselves being vastly entertained by a discussion of the verse-productions of lunatics. Thence we drifted on to a review of the literature of "beer," "beginning with John Still, Bishop of Bath and Wells, whose lusty song is the familiar treasure of all devout beer-drinkers:

> 'Now let them drink till they nod and wink,
> Even as good fellows should do;
> They shall not miss to have the bliss
> Good ale doth bring men to.'"

"Christmas Presents," "Love or Eugenics," and "Wills" followed, and some short, serious, and eloquent pieces on "The Greatest Poetry" and "The Unknown Muse." A most pleasant assortment of literary odds and ends, enhanced by a shrewd knowledge and suggestiveness.

The Islanders of the Pacific. By LT.-COL. T. R. ST.-JOHNSTON. (T. Fisher Unwin, Ltd., 25*s.*)

Twenty-five Years in East Africa. By JOHN ROSCOE, M.A. (Cambridge University Press, 25*s.*)

These are not books of travel, but books on anthropology. The first is by an administrator, the second by a missionary. Both authors write from long acquaintance of the men they describe, and each has succeeded in producing a book that is readable and informative, and that contains a body of information which is a genuine contribution to knowledge.

Col. St.-Johnston's main theme is that present-day Polynesians are derived from a nation which originated from the country north of Mesopotamia—the Armenoid people—and poured forth into Egypt and India, and thence to Polynesia, several thousands of years before the beginning of our era. In support of this he discusses the available evidence derived from a study of language, monuments, legend, totems, sun-myths, and the like, with wide knowledge and intelligent sympathy. The book should appeal both to ethnologists and those interested in the peoples of the Pacific.

Mr. Roscoe went out to Central Africa as a missionary in the eighties, and for twenty-five years ministered to the peoples of the lake region of Uganda. His book is a popular account of these people, their social customs, ceremonies, laws, habits, and religion.

[1] The tomb of King Zer, of the First Dynasty (about 3300 B.C.), was found many years ago at Abydos, some 350 miles up the Nile from Cairo.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

The Friendly Arctic. The Story of Five Years in Polar Regions. By VILHJÁLMUR STEFÁNSSON. Illustrated. (Macmillan & Co., Ltd., 30*s.*)

Lord Byron's Correspondence (chiefly with Lady Melbourne, Mr. Hobhouse, the Hon. Douglas Kinnaird, and P. B. Shelley). With Portraits. Edited by JOHN MURRAY, C.V.O. In Two Volumes. (John Murray, 25*s.*)

Personality and Power. Being the Adult School Lesson Handbook for 1922. (National Adult School Union. Paper covers, 1*s.* 3*d.*; cloth boards, 2*s.* 6*d.*)

SCIENCE

The Failure of Metals under Internal and Prolonged Stress. Edited by F. S. SPIERS, O.B.E., B.Sc. etc. (The Faraday Society, 10*s.* 6*d.*)

Space—Time—Matter. By HERMANN WEYL. Translated from German by HENRY L. BROSE. With 15 diagrams. (Methuen & Co., Ltd., 18*s.*)

Readable School Physics. By J. A. COCHRANE, B.Sc. (G. Bell & Sons, Ltd., 2*s.* 4*d.*)

Distillation Principles and Processes. By SYDNEY YOUNG, M.A., D.Sc., F.R.S. (Macmillan & Co., Ltd., 40*s.*)

Isotopes. F. W. ASTON, D.Sc., F.R.S. (Edward Arnold & Co., 9*s.*)

Notes and Examples on the Theory of Heat and Heat Engines. By JOHN CASE, M.A. (Cambridge: W. Heffer & Sons, Ltd.)

Correspondence

THE RUSSIAN FAMINE

To the Editor of DISCOVERY

SIR,

I write to protest in the name of fair play against the article on the Russian famine in the current number of DISCOVERY. It ascribes the famine solely to the misdoings of the Soviet Government, practically disregarding the main causes—the drought and the Allied blockade, together with the various wild-cat invasions by adventurers that have been financed by our Government, thus continuing the long-drawn-out agony of civil war. The supply of machinery and locomotives has failed because we blockaded the country for political reasons of our own. It is a fact well known to railway experts that the former Government of Russia had been steadily allowing the transport system of the country to deteriorate long before the war began. To ascribe the famine solely to the Soviets is, therefore, a bit of political special pleading that one would not expect to find in a publication that speaks scientifically.

And in expressing the idea that Russia can save herself unaided by other countries, her neighbours, Major Blake stands practically alone. All expert opinion is against him in this. He is apparently the victim of unconquerable political bias. This bias has led him, not only to callous inhumanity, but to a partial and one-sided view utterly unworthy of a scientific journal.

Yours, etc.,
M. P. WILLCOCKS.

35 PENNSYLVANIA ROAD,
EXETER.
March 3, 1922.

To the Editor of DISCOVERY

SIR,

Mr. Willcocks apparently objects to my opinion regarding the direct cause of the Russian Famine.

Possibly the Allied blockade and the various civil wars have helped to make matters worse, but surely these in themselves were the direct outcome of Bolshevik rule.

I maintain, from what I saw myself, from what Russian inhabitants and refugees told me, and from what I have heard from members of the various Relief Commissions working in Russia and Poland, that there can be no doubt at all that the actions of the Soviet authorities are the cause of this dreadful catastrophe. Perhaps one of the chief causes of the trouble was the Soviet order that all grain grown by farmers surplus to their own requirements should become the property of the Soviets. This at once caused farmers to sow only sufficient seed for their own needs and, when the return was less than one-tenth of that expected, the trouble really commenced. Had normal quantities been sown and only a tenth average crop resulted, that would still have been sufficient for the agricultural population to exist on.

Mr. Willcocks has misunderstood me if he believes that I think Russia can save herself unaided. This I do not say, but I do contend that all the efforts of the rest of the world cannot avert the death of millions, and therefore I suggest that Russia had best be left to herself in order that in course of years she may recover, whilst the hundreds of thousands of pounds which are badly needed in our own country should be used for the relief of distress in this country, and not sent to a nation which is neither allied to us in sympathy nor in aim, and upon which relief cannot have any effect other than in slightly prolonging the agony of the starving millions.

Yours, etc.,
WILFRID T. BLAKE.

NEW LODGE, LIMPSFIELD,
SURREY.
March 7, 1922.

[Following our usual policy of publishing criticisms of any article in our journal by readers, and of a reply by the writer thereof, we have printed the above correspondence. At the same time we wish to point out that we completely dissociate ourselves from any views on the Russian Famine, such as those expressed in both letters, approaching a political nature.—ED.]

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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Editorial Notes

In this number Professor Alfred Wegener gives his first account in English of his theory of the origin of the continents and oceans. It has as yet received very little attention in this country on account of the difficulty of obtaining German publications during the war. Professor Wegener first put forward his theory in 1915, and republished it in 1920 under the title "Die Entstehung der Kontinente und Ozeane" ("The Origin of the Continents and Oceans"). We must leave the article to speak for itself, but we here quote the opinions of Professor Weiss, Professor of Botany at Manchester University, writing in the *Manchester Guardian* on March 16, that the new theory is one "of fundamental importance to the sciences of geography and geology, as well as of great interest to the biological sciences," and that "for the moment . . . *it* . . . constitutes a good working hypothesis, and the striking simplicity with which it allows many phenomena to be explained will greatly stimulate further inquiry."

* * * * *

One of the most welcome signs of approaching summer to Londoners and inhabitants of our large manufacturing towns is the less frequent visitation of fogs. For several years past it has been recognised how great is the part played by "chimneys" in these fogs. A problem, however, which has never hitherto been satisfactorily cleared up, is their very sudden development, particularly in London. How many times has one not woken, especially during the "season of mists and mellow fruitfulness," to a clear, blue sky, only to find oneself three or four hours later plunged into the gloom of a "pea-soup" fog? To how great an extent "the quantity of smoke emitted during this time in London is sufficient to account for the quantity of impurity found in the fog," i.e. for the density of the fog, is discussed by Dr. J. S. Owens in a paper in the latest report on *Atmospheric Pollution* [1] issued by the Meteorological Office, Air Ministry.

* * * * *

Dr. Owens made a microscopic examination of the fog air on November 5, 1920. A small jet of air impinged on the glass slide produced masses of particles of about 1/3,000th of an inch in diameter, the individual particles in these masses varying in size from 1/100,000th to 1/20,000th of an inch. "It is noteworthy," writes Dr. Owens, "how very small a quantity of impurity is sufficient to cause a dense fog, and this is doubtless due to the extremely small dimensions of the individual particles." The investigator calculates that, for the production of a really dense fog over London, about 190 tons of suspended matter are required. He estimates roughly that in London factory fires discharge eight or nine tons of smoke into the air every hour, and domestic fires about thirty-five tons, which in "over four hours of winter months would represent 176 tons." It should be noted that the average for the early morning hours in regard to factory smoke would be larger than that calculated from the complete working hours, owing to the fact that "fires are being made up and steam raised for the day's work." "It is not, therefore, remarkable," concludes Dr. Owens, "to find 190 tons hanging over London at 10 a.m. on a foggy morning, as the amount of smoke produced during the previous four hours is sufficient to account for it all."

[1] See under *Books Received.*

In years to come one of the names most honoured in connection with the reconstruction of post-war Europe will be that of Fridtjof Nansen. Dr. René Sand,[1] in a lecture on the Russian famine delivered at Brussels under the auspices of the Belgian Red Cross last February, said that "to look at Nansen is to look on the personification of goodness, energy, uprightness and generosity." Before he was thirty Nansen was appointed Professor of Zoology at Christiania University, and had been the first to cross Greenland, at a temperature of 58° F., dragging his own sledge. In the 'nineties he made the nearest approach to the North Pole that had till then been recorded.

* * * * *

Since the war he has worked with tireless energy, first as High Commissioner to the League of Nations for repatriation of the prisoners of war left in Russia and Siberia, rescuing 380,000 men; later, and after the evacuation of Russia by the armies of Denikin and Wrangel in 1919 and 1920, as the League's High Commissioner for Russian refugees; and is now acting as High Commissioner to the International Committee for Russian Relief. During the last few months he has been risking his life in the most plague-ridden portions of Russia. A century ago nations would have been inclined, under the circumstances, to leave Russia to make her own recovery. The efforts to help Russia that have been made by various nations in Europe and by the United States surely constitute a remarkable development in international consciousness and morality. With that development Nansen's name will always be associated.

* * * * *

That Sir Eric Geddes had a worthy predecessor in a high Roman official, Servæus Africanus, is evident from a letter in the *Oxyrhynchus Papyri* in the British Museum, to which a correspondent has called our attention. The Museum authorities describe it as follows:

Letter from Servæus Africanus, a high official . . . complaining of the useless multiplication of officials in the administration of the estates of the Treasury, in which many people "have devised for themselves various titles, such as administrators, secretaries, or superintendents, by which means they secure no advantage to the Treasury, but swallow up its surplus," and ordering that only one superintendent shall be appointed to each estate," with power to choose two, or at most three, other persons to assist him in his duties." (Dated 13th September, A.D. 288.)

[1] The lecture is published in *The World's Health* (the Monthly Review of the League of Red Cross Societies) for February 1922.

The Origin of Continents and Oceans

By Professor Alfred Wegener

Director of the German Oceanographical Survey

ANYONE who compares, on a globe, the opposite coasts of South America and Africa, cannot fail to be struck by the similar configuration of the two coast-lines. Not only does the great right-angled shoulder of the Brazilian coast find its exact counterpart in the African coast in the neighbourhood of the Cameroons, but the minor curves to the south of these great angles also correspond to one another, every protuberance on the one side fitting into a corresponding depression on the other. This observation has led to a new view of the nature of the earth's crust, according to which the continents in past ages have drifted horizontally over the surface of the earth, and are still in motion at the present time. According to this theory, known as the displacement theory, North and South America were, in Mesozoic [2] times, continuous with Europe and Africa. They then broke away and moved westwards in Tertiary times, the Andes being forced up by pressure on the forward edge of the drifting continent. Again, Antarctica, Australia, and India were formerly in immediate contact with South Africa, India then being the southern end of a long projection from the Asiatic Continent, which is now almost entirely crumpled up and forms the Himalayas. The theory asserts that the outermost rocky crust of the earth no longer envelops the whole globe, as it once may have done, but has shrunk up, in consequence of successive compressions into mountain folds. It is now represented by the continental shelves which are covered only by shallow seas. The bed of the deep seas is regarded as composed of the material of the underlying deeper layers of the earth, upon which the continental masses float. Fig. 1 shows the way in which the continents were formerly joined together, and gradually separated at successive epochs, according to this theory.

It will be evident that this theory conflicts with the former fundamental views of several sciences, and especially those of geology. For a proper judgment upon it an enormous mass of facts must be collected together from such sciences as geophysics, geology, palæontology, palæoclimatology, animal and plant geography, and geodesy. In the decade since the first publication of the theory, much progress has been made towards a wide review of the facts. The theory offers solutions for so many apparent insoluble problems, and so simplifies our views, that the interest of many kindred sciences has been aroused, as is

[2] For footnote see opposite page.

shown by the large and growing literature on the question.

It is impossible in so little space to discuss the evidence which confirms the theory ; this evidence will be found in my book *Die Entstehung der Kontinente und Ozeane.*[1] It must suffice here to give a few of the main lines of proof, drawing examples from each of the sciences concerned.

In drawing up statistics of the distribution of levels over the land surface and sea bottom, geophysicists have found that these heights are grouped about two well-defined values, a land height of about 100 metres and a sea depth of about 4,700 metres. (Compare Fig. 2.) This law has been known for fifty years, so far without any explanation. If the heights and depths had arisen through elevation and depression of a single initial level, as geology has hitherto assumed, then we should expect statistics of level to show a grouping about a single mean value, as shown by the dotted curve in Fig. 2. Instead of this there is a grouping about two values. So we must suppose that there are two initial levels, on which the elevations and depressions have been superimposed ; and this is only possible if these initial levels correspond to two different layers of the body of the earth. The continental masses consist of comparatively light material (such as granite and gneiss) extending downward, according to Hayford and Helmert, to a depth of 100 kilometres. The deep sea bottom is apparently composed of heavier material (such as basalt), in which the continents float like great ice-floes in water. The results of measurements of gravity, and of magnetic and seismic investigations, are in agreement with this conception, and the results of dredging do not contradict it.

Geology provides a very searching test of our supposition that the Atlantic is really an enormously widened rift. If this is the case, the mountain folds and other geological structures which existed before the separation must correspond when we bring the continents together again and reconstruct their original relative position, just as the lines of a torn drawing would correspond if the pieces were placed in juxtaposition. This is actually the case ; the Permian folds of the Cape mountains fit exactly to the Sierras of Buenos Aires, which, according to the latest work of the Argentine geologists, are of the same age and have a completely similar structure. The distance of these mountains from the Cameroons on the one side, and from Cape San Roque on the other, is the same, so that they fit each other exactly in the reconstruction. The direction of folding in the great gneiss plateau of Brazil also corresponds with that in the opposite regions of Africa. In Europe there are three ancient mountain chains which arose in the Silurian, Devonian, and Carboniferous epochs, and these mountain chains are so placed in North America that they appear in the reconstruction as undoubted continuations of the European system. The terminal moraines of the Great Ice Age also appear now as a continuous system. The most striking fact is not the existence of the same features across the Atlantic, but their situation at places which correspond exactly. For example, if the Sierras of Buenos Aires, which are now more than 6,000 kilometres distant from the Cape mountains, lay only a few hundred

[1] Not yet translated into English. Published by Vieweg & Son, Braunschweig. 2nd Edition, 1920.

[2] The geological terms in general use to indicate long periods of past time are tabulated below. As matters of interest, examples of the rocks formed during the period and prominent life-forms of the period are included in the table. In the fifth column are given estimates, necessarily rough and speculative, taken from Dr. Wegener's book, of the number of years between the beginning of the period and the present day.

ERAS AND PERIODS OF GEOLOGICAL TIME

Era.	Period.	Examples of Rocks in the British Isles.	Prominent Life-forms.	Estimate of Years since Period began.
Quaternary	Recent and Pleistocene	River gravels	Man and present-day animals appear	About 1 million
Tertiary	Pliocene	Gravels of E. Anglia	—	2½ million
	Miocene	—	—	6 million
	Oligocene	Clays of Hampshire Basin	—	8 million
	Eocene	Clays of London Basin	Mammals become common and varied in type	10 million
Mesozoic or Secondary	Cretaceous	Chalk of Downs	Birds appear	—
	Jurassic	Sandstones of N. Yorkshire	Reptilian life varied and profuse	—
	Triassic	Salt deposits of Cheshire	Mammals appear	50 million
Palæozoic	Permian	Red sandstones of Nottinghamshire	Reptiles appear	—
	Carboniferous	Coal-seams of British coal-measures	Amphibia appear	—
	Devonian	Limestones of Ilfracombe	Fishes common	—
	Silurian	Limestones of the Welsh Border	Fishes appear	—
	Ordovician	Shales of Central Wales	—	—
	Cambrian	Shales of N. Wales	All classes of invertebrate animals present	500 million
—	Pre-Cambrian	—	—	Greater than 500 million
	Archæan	Gneisses of Highlands of Scotland	No undoubted traces of life	

kilometres farther to the north or south, the features would not fit on bringing the continents together.

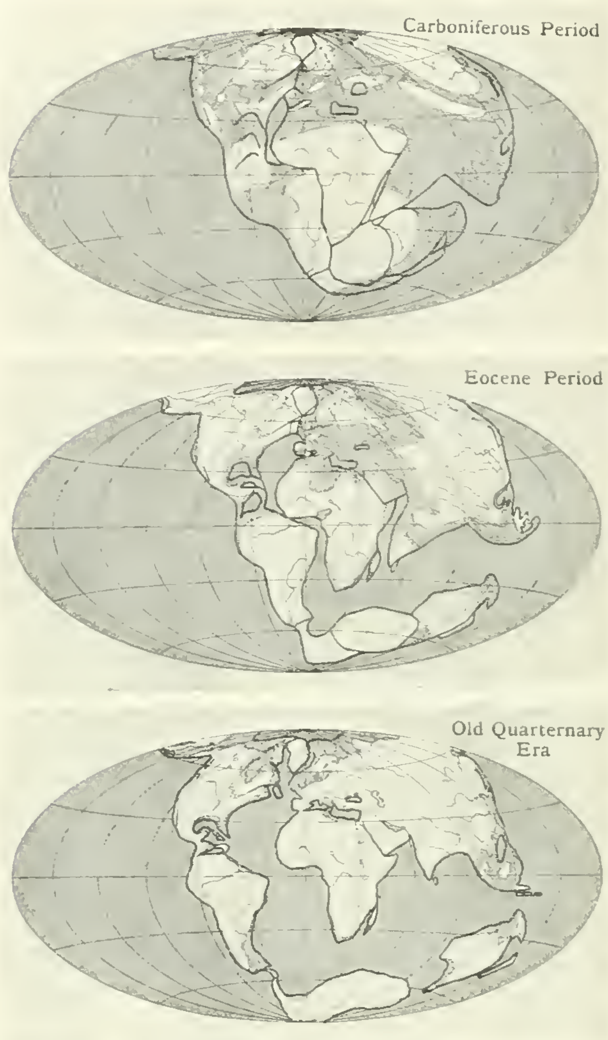

FIG. 1.—THE WORLD IN THE CARBONIFEROUS AND EOCENE PERIODS AND OLD QUATERNARY ERA ACCORDING TO THE DISPLACEMENT THEORY.

White denotes land, dots shallow water, cross-hatching deep sea.

Actually, they do fit, and the correctness of our theory becomes the more probable as such coincidences multiply themselves.

The results of palæontology have led to the assumption of the existence of former land bridges, between continents now separated by deep sea, over which an unrestricted interchange of fauna and flora took place. That such an interchange has at one time taken place is shown by the identity of fossil forms and the relationship of living forms. Now, these land bridges have been assumed exactly in those places where the theory put forward here indicates a former direct connection, as, for instance, between Brazil and Africa, between North America and Europe, between Madagascar and India, and in general between all the southern continents such as South America, South Africa, Madagascar, India, Australia, and Antarctica. It has hitherto been assumed that these land bridges were afterwards submerged, and now constitute the bottom of the deep sea. This conception is physically untenable, for the continents are floating in equilibrium on a heavier underlying layer, and could not sink by so great an amount as five kilometres unless they were loaded down by superincumbent layers to at least an equal height. In addition, when all the necessary connecting land masses are reconstructed it is impossible to find room for the displaced masses of water. Further, the continents now lie so far away from each other that, even if a former land connection existed, it would not account for the identity of their former fauna and flora. These difficulties disappear naturally when the displacement theory is assumed.

From the mass of information to be derived from the geographical distribution of animals and plants we shall only choose a single striking example: the threefold character of the Australian fauna. The most ancient group of animals,[1] which is now found principally in the south-west, shows relationships with India, Ceylon, Madagascar, and South Africa. The second group, to which the characteristic marsupials and monotremes belong, contains, in distinction to the former class, only such animals as can resist cold (mammals, fresh-

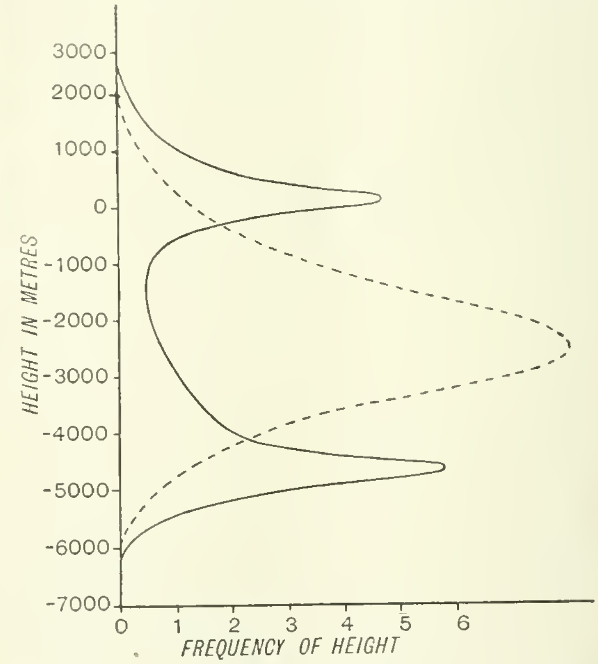

FIG. 2.—THE TWO MAXIMA, AT 100 METRES HIGH AND 4,700 METRES DEEP.

water fishes, but not reptiles or earthworms). This group has penetrated into the eastern Sunda Archi-

[1] The so-called "Gondwanic" group.

pelago owing to the present proximity of Australia to that region.[1] This class has its nearest relationships in South America, now separated from it by a whole quadrant of the earth. The third group, finally, is the fauna of the eastern Sunda islands, which is found in New Guinea and which has established itself in north-eastern Australia. This relationship, formerly so puzzling, is completely explained by the displacement theory. As Fig. 1 shows, Australia, up to the beginning of Jurassic times, was connected in the west with India and Ceylon, and through them with Madagascar and South Africa. This explains the ancient "Gondwanic" group. After breaking away from India, it was still connected through Antarctica with South America, perhaps as late as Eocene times, and this connection gave rise to the second group. Comparatively recently

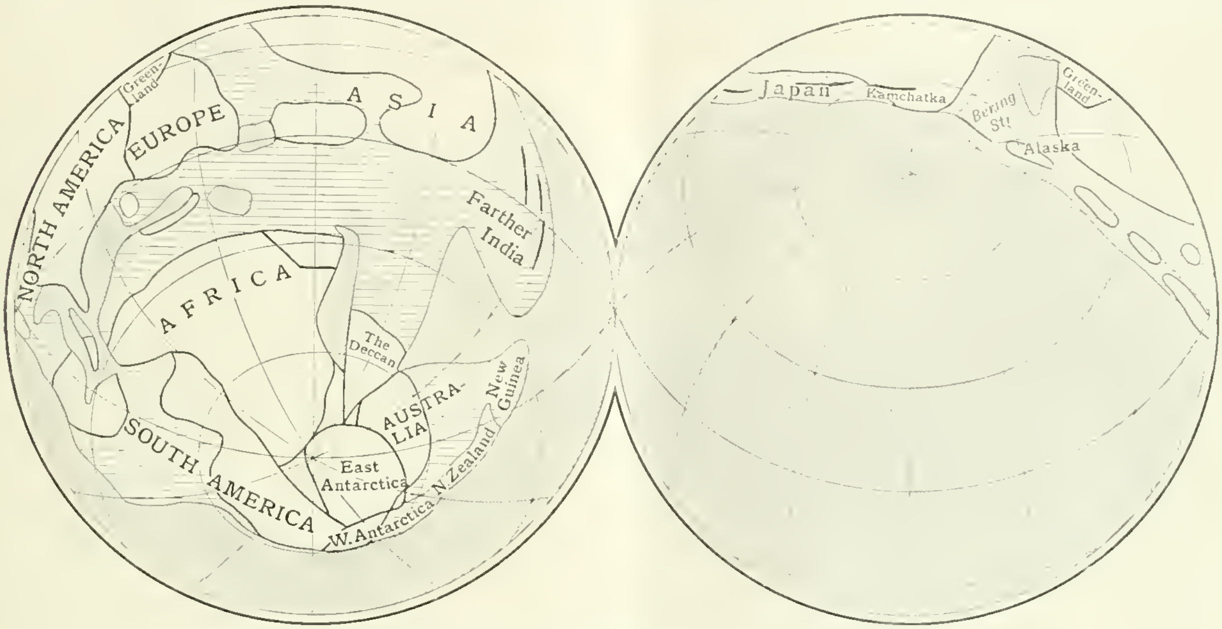

FIG. 3.—THE WORLD IN THE CARBONIFEROUS PERIOD, SHOWING THE POLES.
Diagonal lines denote deep sea; horizontal lines shallow water; unshaded portions land.

Australia drifted into collision with the Sunda islands, with the consequence that an interchange of flora and fauna took place.

In seeking an explanation of former climatic conditions, geologists have hitherto been averse to the assumption of large movements of the earth's poles with reference to the land. However, the idea that it is necessary to assume a considerable movement of the poles in early Tertiary times has recently been gaining more and more ground. It is impossible to overlook the fact that all former attempts to map out the position of the poles throughout the earth's history come to grief on one obstacle, namely, the Permo-Carboniferous ice age in the southern hemisphere. Traces of inland ice at this period are found in Brazil, the Argentine, the Falkland Islands, Togo Island, the Congo, South Africa, India, Western, Central and Eastern Australia. These traces are to-day so widely separated from each other that they cover nearly a complete hemisphere, and even if the pole be placed in the most favourable position, the traces of ice most distant from it would be in a geographical latitude of only 15° and so be in the tropics. On the other hand, we do not know of any certain traces of ice in this epoch in the other hemisphere. This fact has so far constituted a hopeless riddle, and it is no exaggeration to say that it has completely crippled the development of palæoclimatology. The displacement theory affords a striking solution of the riddle; at that period all these continents were grouped concentrically around South Africa, and we thus obtain a connected ice cap of no greater area than that of the quaternary ice-age of America and Europe.

Similar, if less striking, simplifications appear when the position of the pole in other geological periods is determined by aid of the displacement theory, and it is not too much to say that this theory makes it possible, for the first time, to determine the former positions of the pole from fossil evidences of climate in a manner that is satisfactory.

Finally, the displacement theory may be tested by astronomical determinations of latitude and longitude. It is natural to suppose that the movements are still taking place, and the available estimations of geological time, in spite of their uncertainty, allow us to make an

[1] The dividing line, which defines the extent to which this group has penetrated, has been drawn by Wallace between the islands of Bale and Lombok.

approximate estimate of the yearly movement to be expected. It would appear that in many places the velocity of displacement must be too small to be measurable astronomically in a reasonable time. However, in three or four places it should be possible to establish the movement by measurements repeated after a ten years' interval. In the case of the movement of Greenland relatively to Europe, I. P. Koch (the cartographer of the Danish Expedition of 1906–8) has made a comparison between the observations of this expedition and those of the second German North Polar expedition of 1870 and still older observations of Sabine in 1823. He has succeeded in deducing evidence that the distance of Greenland from Europe has noticeably increased in the interval, by an amount exceeding considerably possible errors of observation. There is evidence of a movement of about 15 metres a year which is in complete agreement with that to be expected from the displacement theory.

We will conclude with this the series of examples from our chain of evidence. If the standpoint of the displacement theory be taken up, numerous problems immediately present themselves, of which the most important is perhaps the nature of the forces which give rise to the displacements. Here no final conclusion can be reached, but the problem has been so far examined by the theoretical physicists and geophysicists as to leave no doubt as to the possibility of such a force existing. According to the displacement theory, the continents display, in general, a movement towards the West and towards the equator. Köppen ascribes this latter tendency to the action of the force directed away from the pole which tends to drive towards the equator all floating bodies whose centres of gravity are higher than their centres of buoyancy. This force has been calculated to be of the magnitude of one three-millionth of the weight of the body, and so to be rather more than the tidal force. It may be shown that this force is sufficiently great to pull the continental masses through the underlying layers with the necessary slowness, even if these layers are as rigid as steel at ordinary temperatures. On the other hand, it seems questionable whether this force can explain the great Tertiary mountain folds, which extend from the Himalayas through the Alps to the Atlas Mountains, along the line of the equator in those times. It is not impossible that at that period, and perhaps in the earlier Carboniferous period, still other forces existed in addition to the normal force directed from the pole, owing to rapid displacements of the pole and the consequent readjustment of the figure of the earth to the new polar axis, these forces being perhaps twenty to a hundred times as great. This would give a possible explanation of the fact that this equatorial mountain folding is limited to these periods.

Just as the movement from the poles manifests itself principally in mountain folds along the equator, so also the westward movement of the continents is evidenced by many striking features of the earth's face which has hitherto been completely unexplained. We have already instanced the frontal resistance which the American continental masses experience in moving through the ancient and deeply cooled bottom of the Pacific, a resistance which has led to the throwing up of the gigantic mountain chain of the Andes. Since this frontal resistance must have a much greater influence for small masses than for large, these small masses will be left behind in the general westward movement. Thence arises the great sweep of the Antilles, left far to the east by America, and the great bend of the so-called southern Antilles between Tierra del Fuego and West Antarctica. Thence also comes the partial separation of the eastern edge of Asia in the form of chains of islands, and the separation, long ago completed, of the former Australian coastal chain which now forms New Zealand. By the same movement Ceylon has been broken away from India, and we see evidence of it also in the bending of all the ends of continents towards the east, such as the southern end of Greenland, of Tierra del Fuego and the northern end of Graham Land. Schweydar has suggested an origin for the force driving the continents westward which he believes to be due to the procession of the earth's axis, but the whole question of the origin of the forces is so much in a state of flux that it is impossible at present to reach any final conclusions.

New Light on Old Authors

IV. THE GOLDEN BRANCH

By R. S. Conway, Litt.D., F.B.A.

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MOST of us who have any interest in primitive religion and folk-lore know the name of Sir James Frazer's great book, *The Golden Bough*. But it is quite likely that a large number of those who have from time to time quarried in its wonderful mines of learning, or strayed in its charming avenues of fancy, would find it hard to say just why he gave it that name. And even if they did remember something about the Vegetable-Spirit, they might still find it difficult to know how it was connected with Vergil's story of the descent of Æneas into the Underworld, and his having to pluck a golden branch from the midst of a dark forest in order to traverse that world unscathed. And in truth their difficulty would be pardonable,

since it has worn more than one look to the distinguished author himself; for latterly[1] he seems to have modified the particular theory, which he had in part taken over from some ancient mythologist, connecting Vergil's golden branch with the weird custom of the runaway priest or "king" (*rex nemorensis*) of Diana's grove at Nemi. This person, always a runaway slave, became "King of the Forest" by slaying his predecessor, and remained king until he failed to defend himself against some new aspirant:

> "The priest who slew the slayer
> And shall himself be slain"—

so Macaulay described him.

Instead of regarding the King of the Forest as the Vegetable-God incarnate, who has to be sacrificed[2] as soon as another candidate for godship who can boast a larger portion of Vegetable-Spirit (i.e. of physical strength) appears in the neighbourhood, Sir James later on counted him as a survival of the religious side of the kingship of some tribe, whose name is not recorded, but who, for some reason or other, dumped their King-Spiritual into the somewhat depressing surroundings of Diana's temple at Nemi, just twenty-five miles from Rome, with no one to see that the rules of his sacred game were kept, and went off to some region, also not recorded, with their King-Secular to conduct their public business for them without having to worry himself any further about oaken boughs and godships and murderous rivals.

The result is that poor Æneas was left rather in a mist. We know that he plucked a golden branch, that he carried it with him to the Underworld, and that he fixed it on the door of the infernal palace of Queen Proserpine, the bride of "dusky Dis." But why Æneas did all this Sir James Frazer does not seem to tell us so confidently as before; yet he would still like us to think of the branch as embodying the life of the Oak-tree—though it was a holm-oak (*ilex*), not an oak (*quercus*), on which Æneas found it; and though it is likened by Vergil to a mistletoe "alien to the tree on which it is growing." For all that, most of us will gladly believe all that Sir James can tell us about oaks—at least, short of identifying the *quercus* and the *ilex*; but all the oaks of the forest bring us no nearer to Charon or Proserpine. On the contrary, as Sir James (following Dr. A. B. Cook[3] and Dr Warde Fowler[4]) most justly insists, they point us up to Jupiter, the god of heaven.

Nor can the latest and most learned of commentators on the Sixth Book of the *Æneid*, the great Berlin scholar, Eduard Norden, find a word of explanation to offer, beyond the conjecture that Vergil must be following some piece of folk-lore unknown[5] to us. Is there, I wonder, any other incident in the whole range of ancient story which is, in itself, so fascinating and romantic, so arresting even to a child's imagination, about which so absolutely nothing is yet known?

After this the reader will not expect in this article any complete theory of Vergil's motive for devising the incident or for giving it so central a position in his story. But there is, I believe, one avenue of interpretation which has not been sought. And yet to most of us it is far the most important of all lines for search, even though it may not be very satisfying to those who study Folk-lore for its own high scientific sake. I mean the question whether in Vergil's own poem there are any indications of the kind of ideas with which this picturesque detail was linked in his mind. Whether, in other words, Vergil had, even in part or at times, any thought of an allegorical meaning beyond the plain value of the Branch as helping the movement of the story; and, if so, what that allegorical notion may have been.

No one can be confident that Vergil would have been willing to answer such questions if we had put them to him. He might have told us that we could read the story for ourselves; that we were welcome to profit by anything we found in it; but that he could not put his story into prose, not even the prose of Philosophy, because that would destroy it. He might even ask us in our turn whether we did not like the Golden Branch where Æneas plucked it, and where Æneas left it; whether we did not think that it was in place in either case; whether we thought there could have been such a story without it. All this, Master Vergil, as Roger Ascham no doubt called him, might fairly ask us, and we could only answer each question in one way.

Nevertheless, readers of poetry, though they may not want the poetry altered by a single scene or word, have after all a right to try and translate it into their own humble prose; and, indeed, if they do not attempt such a translation, they can never be quite sure that they have reached the meaning which it really carries. A poet may and must put his suggestions into pictures. But his readers will always ask what the picture means. And if we find that a

[1] See, for instance, his *Lectures on the Early History of the Kingship* (1905), p. 25, where he writes of a statement of Servius: "I greatly regret that in former editions I missed its significance entirely." Or the preface to *Balder the Beautiful* (1913), where he speaks of the runaway priest of Nemi as a "puppet" which has served his purpose and may now be put into the lumber-room.

[2] See *Golden Bough*, Edition 1 (1890), c. 3.

[3] *Zeus, Jupiter, and the Oak*, Cambridge, 1920.

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[4] *Roman Essays and Interpretations*, Oxford, 1919.

[5] Reasons which have nothing to do with Nemi or its priest were suggested by Sir James Frazer in the second edition of his *Golden Bough*, iii. 405, footnote 5.

particular image in any one poet is closely associated with a certain train of thought, then at least we may be sure that there is nothing in the image which will be inconsistent with that thought; and we may guess, though we cannot be sure, that that thought itself is some part of what the image was intended to suggest.

So our enquiry here will not be a matter of folk-lore; not what the ancient Italian peasants believed about the mistletoe, nor why they believed it, interesting as such questions may be, but rather this: what ideas does Vergil connect most closely with this golden image? It was essential to the purpose of Æneas, that much everyone sees. It carried him through the Underworld in safety; it kept him living in a region where all else was dead; it reduced the "grim ferryman," Charon, to obedience; it made even the ruling powers of the dead world complaisant. Is it not, then, well to ask what else there was essential to the errand of Æneas? What commands are given him? What kind of motive is enjoined upon him? What kind of a meeting does he seek, or find? What kind of a revelation crowns his journey? All this contributes to the question to which, from another and more general point of view, I have sought an answer in a lecture recently published on *The Philosophy of Vergil* [1]; namely, what was the central and most characteristic part of Vergil's view of life?

But we must not stray yet from the Golden Branch and its immediate surroundings. Into what class of persons was Æneas admitted by the privilege of gathering it? The Sibyl tells us, "those few whom just Heaven has loved, themselves of divine birth," who have been allowed to enter and leave the Underworld alive. Clearly, therefore, there is something essentially divine about the Branch, some element of majesty superior to ordinary mortal limitations. But can we further discover in what this divine majesty consists?

What is Æneas sent to do? Nothing in itself transcendent, not to rescue a bride, or to make any change in the gloomy region he enters. No, he is only going to see his father. True, he is to receive from him a revelation. But the revelation has largely been given already. He knows already from other sources that he is to found a new nation, and a great nation; and he has actually reached Italy, which is to be that nation's home. What he has to learn is mainly the importance to mankind of the work which that nation will do; in particular the restoration of the Golden Age, to be accomplished by the great Augustus. For in his day, peace was to return to an afflicted world; justice, free intercourse, harmony and merciful government was to be everywhere established. That is the climax of the revelation. But at the moment when Æneas is seeking the Branch he has in his mind nothing but the longing to see his father; and when he arrives, his father greets him knowing nothing of the Branch, but only seeing the cause of his son's triumph over the powers of darkness in that son's affection. So that, whereas the Sibyl might have said, "It is the Golden Branch that has brought you here," Anchises does actually say, "It is your own *pietas*, your own devoted affection, which I knew would not disappoint me."

This double description of the power which brought Æneas on his way is most characteristic of Vergil. First, the supernatural image linked with old folk-lore in the poet's mind; and, secondly, the natural motive which Anchises—who, after all, saw things from a loftier point of view than the Sibyl—recognises as the moving cause of the journey.[2]

But again, how did Æneas come to find the Branch? Only because he delayed his departure from the upper world in order to render the last honour he could to a friend who had been suddenly cut off; and to render it by hard work, felling trunks of trees to build a lofty pyre, and penetrating into the heart of the wood to seek them. The Golden Branch, then, would seem to grow somewhere beside the path which men tread who do honour to their friends at some cost to themselves.

Again, when does Æneas find it? The discovery is granted in direct answer to a prayer. That, of course, is not strange, seeing what divine power the Branch has when once discovered. Yet it adds a point to its character. It is divine, we knew. But we know now that it is given to those—and presumably only to those—who approach its divine creators and sponsors in the attitude of reverence and of what in Christian phraseology might be called faith.

Yet again, how are the eyes of Æneas actually guided to the Branch? By two twin doves whom he recognises as sacred to his mother, Venus; they fly before him into the forest just far enough to lead him on without passing out of his sight; and they finally settle on the tree "whence through the boughs flashes the strange, half-breathing gleam of gold."

Now in the *Æneid* Venus is a distinctly mixed character. She often does a great deal of harm. But so far as Æneas is concerned she is always trying—in her own too clever ways—to do what a mother should; and in his relation to her there is never anything but reverence and affection, which indeed appear here in

[1] The editor of the *John Ryland's Library Bulletin* kindly allows me to offer to the readers of Discovery some account of the investigation which is traced more fully in the pages of that journal (vol. vi, p. 384).

[2] Other examples of this habit of giving double causes, natural and supernatural, side by side are collected in the article just referred to, pp. 389 ff.

his words at the point when he sees the doves. And the doves themselves are surely connected with the better side of the activities of Venus. They suggest not the storm and stress of passion, but the calm of steady and settled affection, the light and warmth of home.

My point need not be, surely, laboured further. If the Golden Branch was not connected in Vergil's mind with the strength of natural affection, with the ties between father and son, between son and mother, between friend and friend, then it was at least a most happy accident that, in his story, linked such motives so closely to so beautiful an image. And in great poets accidents rarely happen.

Without some specific declaration on the part of the poet himself, such as good John Bunyan loved to prefix, and infix, and superfix to every part of his allegories, or such as Spenser and Milton did not always disdain to add to the stately figures of their own creation—without some such confession on the poet's part we are, of course, bound to limit our conjectures with a prudent "perhaps." Yet one thing at least about Vergil is not a "perhaps," but quite certain and demonstrable; namely, that to him the central interest of the world was in human affection. In this lay what for Vergil was the supreme paradox of life; the supreme example which proved the need of stating things by antithesis, of always seeing two sides to every human event.

In the paper to which I have referred, evidence is given at some length of Vergil's habit of double sympathy; of the way, for instance, in which he cannot picture the bees being caught and killed by the swallows without indicating in one and the same [1] line his sympathy both with the hapless bees and with the hungry young swallows, whom the bees are slain to feed. This is a tempting theme which I must not develop further here. Every thoughtful reader of Vergil will be able to recall other examples; the greatest is in the tragedy of Dido.

There was only one thing to Vergil that really mattered in this world, and that was the affection of human beings, their affection first for their own human kind, secondly for their fellow-creatures, and, thirdly, for the power which we call Nature, who to Vergil was a being not less throbbing with life and affection, not less bountiful of love to men, than any human mother to her child. Need I attempt to illustrate this side of Vergil's personality? Through all the ages it is this which has endeared him to thousands of unknown readers who, through the veil of mist raised by the strangeness of his tongue and the distance of his times from their own, have felt the central, inner glow of his human affection, the throbbing pulse of that great heart. Think of his picture in the *Georgics* of the farmer at home with his children hanging round his kisses; think of the delight with which he notes the ways of animals small and great, but especially the small ones—birds and insects and little creatures of the soil; how more than once [2] he bursts into an enthusiastic avowal of gratitude to the beneficent power that strews men's path with blessings. But perhaps, since the *Æneid* is less often read as a whole, we are less conscious how often the same note sounds in that poem. Think of the line in the Sixth Book where, among those who receive the highest honour in Elysium, the snow-white garland, the last class consists of those who, "by their good deeds, have made two or three folk remember them" (*quique sui memores aliquos fecere merendo*). With what gentle sympathy does Vergil sketch the figure of every aged man—Anchises, Evander, Latinus—and of every youth—Pallas and Lausus, Nisus and Euryalus? Or when Galæsus is slain at the outbreak of the fighting in Book VII, failing in his efforts to pacify his countrymen, how many readers have noted how his flocks and herds at home and all the people of his farm are brought into the picture to represent the mourning for their master? Or think of the feeling shown for Silvia's pet stag, whose accidental wounding by Ascanius is the signal for the outbreak of war. This incident is actually censured by a wise modern critic as merely pretty and Alexandrine, quite beneath the dignity of the Epic!

But I need not prolong the enumeration. Let me ask the reader only to realise the tragic paradox which Vergil found beneath this lovingkindness of the world: the fact that our human affection is the source both of the only joys worth counting joys, and of the only sorrows worth counting sorrows. Every one of the troubles of the *Æneid*, every one of its tragedies, springs ultimately from this. The tragedy of Dido, first from the misguided affections [3] of Juno and Venus, and then from her own; the tragedy of Juturna from her love for her brother; the war in Latium from Silvia's affection for her stag and her followers' affection for Silvia; the second outbreak from Turnus' love for Lavinia and his followers' devotion to Turnus; the tragedies of Brutus and Torquatus, briefly mentioned in the vision of Anchises; the tragedy of Marcellus, pictured at the end of the same revelation—the essence of all these lies in the affection of some men or women, ill guided or ill governed, or crossed by physical calamity. With the solitary exception of Drances (who plays but a small part), there is no such

[1] *Georgics*, iv. 17.

[2] *Georgics*, ii. 323 ff.; 433, 516.

[3] These were of a political, nationalist type, but affections none the less; see a fuller discussion of this in my *New Studies of a Great Inheritance*, p. 161.

motive in the whole of the *Æneid* as that from which the *Iliad* starts, the high-handed selfishness of one primitive chieftain compensating himself by robbing another. Compare and contrast with this the crowning scene of the *Æneid* in which the conquered Turnus might have been spared but for what, to the ancient mind, was his inhuman cruelty to Pallas and his father, of which he still wore the trophy in the baldric of Pallas girt upon his own shoulder. Such an offender must not survive into the new era; the violence of Turnus would have continued to trample on the sacred laws of humanity; yet even Turnus Vergil could not doom without a note of pity; in the last words of the whole epic the soul of Turnus passes "indignant to the shades."[1]

Now it was in this common source of human sorrow and human joy that Vergil found the supreme paradox which for him wrapped the world in mystery. Yet, strange and mysterious as the contradiction was, he held it to be the key of life.

Here, I believe, we have reached the centre of Vergil's thought. All the sorrow and all the joy of the universe seemed to him to spring from one root, and he accepts, nay, he welcomes, them both. There could be no human affection, so Vergil saw, unless it were such as to make its possessors capable, and capable in equal degrees, of the most exquisite suffering and of the most exquisite joy. This to him is the fundamental fact of the universe—that all pain and all joy is to be measured simply in terms of human love. And if you ask him his last word upon this mystery, the mystery on which he has pondered year after year, viewing it from both sides, through all his study of life, he will tell you that the Golden Branch is always found in the shadows of the forest, when it is sought in fulfilment of duty. And while others may turn away from the sight or thought of those shadows in mere dread or disbelief, Vergil will bid us, like his hero, pluck the Golden Branch eagerly and trust it gratefully, to bring us through even darker shadows out into the light beyond; to trust that somewhere, somehow, Death itself is overcome by the power and persistence of Love.

The best translation of Vergil is the verse-rendering of the *Æneid* and now of the *Georgics*, by Mr. James Rhoades. (Longmans, Green & Co.)

[1] This point is developed more fully in *The Messianic Eclogue of Vergil*, p. 46.

NOTICE

The June number of Discovery will contain, amongst others, articles on *Unemployment and Taxation*, by Professor Douglas Knoop; *Some Recent Work on the Ductless Glands*, by Dr. L. T. Hogben; *Fertility Rites in Modern Egypt*, by Miss W. S. Blackman; and a concluding instalment of Professor D. Fraser Harris's paper on *Biology in Shakespeare*.

The Airways of Europe

By Major W. T. Blake

Europe is rapidly being covered by a network of highly organised airways. Already it is possible to fly on regular services between the capitals of the greater number of European countries, and by the summer, services now being arranged will be operating to most of the large towns west of Russia.

At the present time France controls by far the largest number and the largest mileage of airways. The generous subsidy granted by the French Government partly accounts for this, but more important still is the fact that our Allies are keenly alive to the commercial possibilities of aerial transport. At the present moment Paris is the most important air-centre of the whole world, though in respect of organisation the Paris terminal aerodrome at Le Bourget cannot compare with London's terminus at Croydon, which is the largest and best-equipped commercial air station in existence. By next summer it is highly probable that Croydon aerodrome will accommodate as great a volume of traffic as that now passing through Le Bourget. When the Allied restrictions are removed, Germany will make a big bid for the aerial traffic of the world, and plans have already been made for the extension of the many services which are already running with great regularity throughout the whole part of the German Republic.

From Paris services run (*a*) to London, (*b*) to Brussels, Rotterdam and Amsterdam, (*c*) to Strassbourg, Prague, and Warsaw, (*d*) to Havre, (*e*) to Lucerne; and a service via Strassbourg and Prague to Vienna, Bucharest, and Constantinople will be opened shortly. Other French services proceed from Toulouse via Barcelona, Alicante, and Malaga to Rabat and Casa Blanca in Morocco, whilst a service from Marseilles to Genoa is being organised. There are also several smaller services which operate between various towns. By means of this network of air lines the traveller can proceed from Paris to London in about three hours, instead of the eight hours required by boat and train; to Warsaw in less than twelve hours for the complete journey, as against nearly fifty by train; or by taking the train to Toulouse and thence using the airway to Morocco, can cover the journey to Casa Blanca inside two days, as against nearly four days' travelling by rail and steamer. There is also a probability that an airship service from Marseilles to Algiers will shortly be put into operation.

After France, Holland controls the largest mileage of airways, the K.L.M. service operating from Amsterdam to Rotterdam and London in one direction, and to Hamburg, Bremen, and Copenhagen to the

north. A service also connects Amsterdam, Brussels, and Paris. It is probable that these lines will be extended this year.

Germany, despite the inter-allied restriction on the manufacture of aircraft and the exploitation of airways, is rapidly going ahead with aerial transport. Practically all Western and Eastern Germany is linked by a network of airways over which aircraft ply with great frequency and regularity, carrying mails, passengers, and goods. To encourage the use of air mails, the German Government has reduced the postage fees with such success that aircraft carry large quantities of letters on every flight. Services are being organised to link up Germany with Esthonia and Latvia, and there is every probability of the large German firms of Junkers and Sablatnig being moved from Germany to one or other of these Baltic Republics in order that they may carry out their activities without restrictions. It is possible to fly from London to Berlin within a day, taking the K.L.M. service from London to Bremen, and thence continuing to Berlin by the Lloyd-Sablatnig airway. The German Zeppelin firm is also responsible for the coming airship service from Spain to South America.

Portugal is now coming into the world of civil aviation with services from Lisbon to Paris via Valladolid and Bordeaux and other lines, from Lisbon to Corunna, and from Lisbon to Madrid, but few particulars of these new services are available other than the fact that the capital of the company concerned is 2,000,000 escudos.

Britain comes a poor fourth in the development of the airways if one considers mileage only. At present one route alone is being exploited by British companies—that from London to Paris, over which two companies, the Instone Air Line and the Handley-Page Transport, operate regularly.[1] The recent granting of a subsidy for aerial transport has encouraged other firms to investigate the question of aerial transport, and services will shortly operate to Brussels and probably to Amsterdam as well as to Paris. It is a pity that Britain is so far behind other countries in the development of her airways, since her organisation for aerial transport is the best in the world; her machines are unbeaten by those of any other country; and the qualities of British pilots are so well realised that several foreign companies employ them in preference to pilots from their own nation.

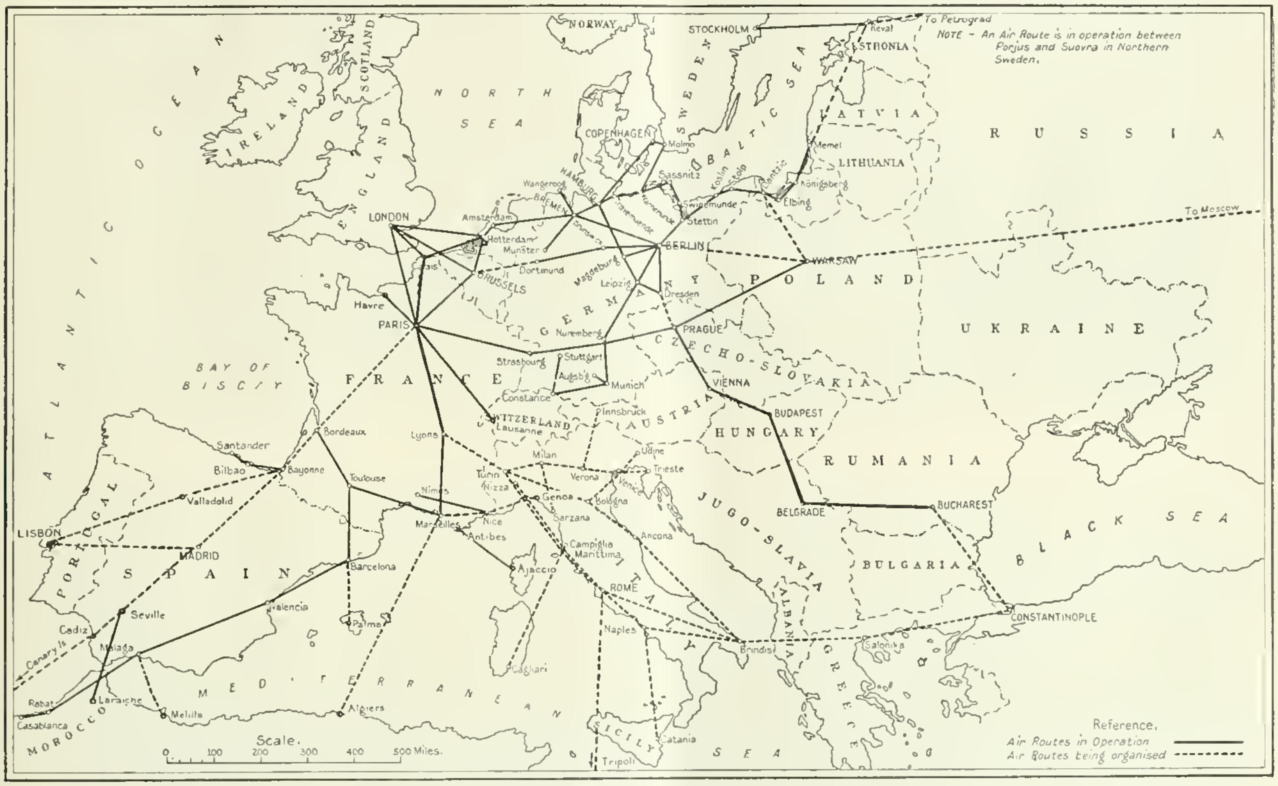

FIG. 1.—A MAP SHOWING THE EUROPEAN AIRWAYS.

Many people have been deterred from travelling on the airways because they believe that air travel is unreliable, if not dangerous, uncomfortable, and expensive. With regard to the question of unreliability and

[1] Daimler Hire Ltd. has also commenced operations on the London–Paris service since this article was first written.

Fig. 2.—ZEEBRUGGE AND THE FAMOUS BLOCK SHIPS.
Passed over on the London-Amsterdam route.

Fig. 3.—ROTTERDAM.
Passed over on the London-Amsterdam route.

danger, it is well to bear in mind that aerial transport is yet in its infancy, but can already show a greater percentage of reliability and safety than any other form of transport at a corresponding or even much later stage of development. One has only to take into consideration the almost daily charabanc fatalities so realise the truth of this statement.

As regards actual figures, for the year ending September 1921, 4,559 Continental aircraft used Croydon. Of this total 1,315 were British, 1,436 French, 577 Belgian, and 295 Dutch. For the same period a total of 10,554 passengers were carried between London and the Continent, 5,424 being carried in British machines, 4,024 by French, 676 by Belgian, and 420 by Dutch companies. During this period the following casualties occurred on British air lines: pilots killed, 3; passengers killed, 4; third party killed, 0; pilots injured, 3; passengers injured, 2; third party injured, 0. The casualty rates during last summer work out at ·03 passengers killed per thousand carried, and ·03 passengers injured per thousand carried, whilst a total of 32,200 miles was flown over for every accident which occurred. Other figures show that one accident occurred for every 1,718 flights commenced. These figures, which are issued by the Air Ministry, show that air travel cannot be considered as unduly dangerous.

For the three months ending July 31, 1921, the British services between London and Paris came up to the high standard described as "100 per cent. efficient," whilst for the six months ending September 21, the average "efficiency" was 96 per cent.

Other European countries interested in civil flying are Belgium, which operates routes to London and Paris, and Denmark, which will enter the field this spring, probably employing German machines. Spain, too, is operating a regular service from Seville to Laraiche in Morocco, and has other services in contemplation, notably the airship service to South America already mentioned.

As regards comfort, everyone who has flown realises that air travel is the quickest method of getting from place to place, and speed in transit adds to comfort in travelling by taking away the monotony of long journeys. All machines now used on the airways are fitted with closed cabins carrying from two to twenty people. These cabins are invariably fitted with comfortable armchairs, and are generally well ventilated with windows which may be opened or closed at will. They are comparatively warm in winter and not unduly stuffy in summer weather. There is none of the jolting and banging experienced in rail and road travel; there is no dust or cinders to irritate the travellers' eyes; there is no excessive draught to injure delicate gowns. The sensation of bumping sometimes felt when flying low over hilly country on a hot day is the worst that can be experienced, and it is not nearly so bad as a sea voyage in comparatively calm weather. The views seen from the windows of the machine are generally good, and the panorama seen by the traveller is superior to anything of the kind which can possibly be obtained by people who travel by old-fashioned methods.

All cross-Channel companies provide their passengers with life-belts which automatically inflate from a compressed-air condenser by moving a small lever. This is to guard against danger in the event of a forced landing in the Channel, though all the machines will float a certain length of time on water, and since civil aviation commenced there are only two recorded instances of commercial machines having to descend in the Channel. In addition most aeroplanes have an emergency outlet at the top of the cabin as well as a normal entrance by a full-sized door. At least one company has a map of the route inserted inside the cabin on which the exact position of the machine is shown by a pointer which the pilot moves as he flies over the route. It should be borne in mind that there is no necessity to wear special clothing when travelling by air. The most delicate costume will not get injured, and nothing more than a light wrap occasionally in summer, and an overcoat in winter, is needed by any traveller.

What is a Chemical Element?[1]

THE publication of Dr. Aston's monograph on a subject he has made peculiarly his own affords a convenient opportunity for a few reflections upon the change in our conception of a chemical element which recent research work has occasioned. The exact idea conveyed by the word "element" in chemistry and physics in the past has been more easily realised or felt by students than expressed in words. The textbooks told, and still tell, us that an element is a "body which has not been decomposed"; or, is "something to which we can add, but from which we can take nothing"; or, a "body which increases in weight with every chemical change." Such definitions have always been regarded as unsatisfactory because they were provisional; a time might conceivably come when they would be inapplicable to a given case. They took their stand, as Sir William Crookes pointed out, not on any attribute of things to be defined, but on the

[1] *Isotopes.* By F. W. Aston, D.Sc., F.R.S. (Arnold, 9*s.*)

limitations of human power ; they were confessions of human impotence.

Now since it is known that all bodies are composed of atoms—the smallest particles of matter that can take part in a chemical change—it follows, it was argued, that an element must be composed of atoms of one kind only, for if it were composed of two or more kinds, it is very probable that someone, ere now, would have separated one from another, and that would contradict the definition of the word.

In the old days, then, an element was believed to be an assemblage of atoms each of which had identical properties. The truth revealed by experiment, however, differs from the conclusion of the argument above. We now know that what was called an element may contain atoms of different kinds, but—and this is important—although these kinds differ in a few respects, in most they are so similar that they cannot be separated by any known chemical process. Had this conclusion originated in a man's mind as a bright idea, it would surely have been rejected as making unnecessarily complex something essentially simple. Yet the experiments of workers on radio-activity in the years immediately preceding the war, and of Dr. Aston on positive-rays in the years since, have rendered it extremely probable.

Let us take an example from Dr. Aston's book. The metallic element magnesium, whose atomic weight is 24·32, is found to consist of three bodies having atomic weights of 24, 25, and 26. Each of these, as far as we know, is an assemblage of absolutely similar atoms, and therefore is an element in the old sense. Magnesium, on the other hand, although it is known by physical means to be a mixture of the three, cannot be separated by any known chemical process into its constituents. Not being decomposable, it too is an element.

Which, then, is to be called an element, the embracing whole or the constituent part ? If the three magnesiums be called elements, they must be given distinguishing names and a new name must be invented for their mixture ; also the word "element" would then mean something different from what it has meant in the chemical and physical literature of the past century. The difficulty is best resolved in this way. It is known that each of the three magnesiums gives absolutely the same X-ray spectrum, which is, therefore, that of the composite body. Now the X-ray spectrum is believed to be the most fundamental property of a chemical element. It is an excellent thing, therefore, on which to base a definition. Ninety-two (but only ninety-two) different X-ray spectra are known to be capable of existing in nature, and eighty-seven of these have actually been found in an examination of bodies. It is simplest, therefore, to make the X-ray spectrum the distinguishing criterion of a chemical element and to define an element as a substance possessing a unique X-ray spectrum. On this view there can be but ninety-two different elements of which eighty-seven are known.

It follows from this that if a substance is shown by the positive-ray method or otherwise to be a mixture of non-separable constituents, the mixture is called an element ; if it is shown to be wholly one constituent, that too is called an element. Each of the constituents of the mixture which comprise the element is called an isotope. An isotope, but not necessarily an element, is consequently an assemblage of absolutely identical atoms. Those elements which are found to be mixtures of isotopes are called "complex" elements, those which cannot be resolved into isotopes, "simple" elements. Remembering that isotopes are non-separable, we arrive at the following description of an element : *A substance with a unique X-ray spectrum, which may or may not be a mixture of isotopes, and which cannot be decomposed into anything simpler by any known chemical process.*

The following elements have been found to be simple (I quote from Dr. Aston's book): hydrogen, helium, beryllium, carbon, nitrogen, oxygen, fluorine, sodium, phosphorus, sulphur, arsenic, iodine, and cæsium. Of the elements found to be complex, lithium, boron, neon, silicon, chlorine, argon, potassium, nickel, bromine, rubidium, actinium, protactinium, uranium, and possibly calcium, consist of two isotopes ; magnesium and possibly silicon of three ; thallium and possibly zinc of four ; xenon of five ; krypton and possibly mercury of six. The elements which have not been classified remain still to be investigated.

A. S. Russell.

Some Religious Beliefs and Survivals in Rural Japan

By the Rev. Walter Weston, M.A., F.R.G.S.

Late British Chaplain at Yokohama

Nothing so strongly shows the contrasts between the Japanese townsman and the Japanese peasant as a growing familiarity with the religious ideas and customs of the vast majority of the peasantry and of the dwellers in the remoter regions of the interior. They are a shy folk in these matters, simple-minded, and not

at all ready to talk to the stranger about either the details of their old-world practices or the principles on which those practices are based. Such details will only be gleaned by one who has been able to move among them during years of friendly intercourse, and to gain their confidence without exciting suspicion either by the inquisitiveness of the investigator or the superiority of the critic.

The present paper is an attempt to illustrate, mainly from personal observation, some of the popular ways of regarding the unseen powers that lie behind the phenomena of the visible world, and of the observances that are the natural result of that outlook upon it. It must be owned at the outset that the subject is one in which the modern and very much up-to-date representative of that Japan which is, and very naturally, chiefly concerned with its own wonderful achievements in the adoption of Western civilisation, takes little interest, and for which it has but little use.

The religious ideas of rural Japan with which we are now dealing are such as have been widely held almost from the dawn of the nation's history, and for the most part long preceded the introduction of Buddhism from China in A.D. 552. For the purposes of the present paper it may be convenient to define religion as that which includes all man's relations with the Divine, while religious conduct may be said to consist in doing that which is pleasing to the superior powers and in refraining from such acts as may be thought offensive to them. While not forgetting the influence exerted in the past by the ancestor-worship and Buddhism mainly derived from abroad, the real religion of rural Japan may broadly be described as a deification of the powers of nature by a people who were on every hand, and to an extent beyond all other peoples, not only in closest contact with the operations of those powers, but possessing every reason to study their workings and to desire to be on the best possible terms with them. The character of the Japanese peasant's religion cannot clearly be understood until we realise the enormous influence exerted on his whole outlook upon life by the physical surroundings in which he dwells.

In no other land of a similar area do the aspects of nature combine such a variety of grandeur, destructiveness, and beauty. Almost everywhere volcanic eruptions and earthquakes are frequent ; towns and villages on the sea-coast are often much damaged by tidal waves ; and the typhoon is more dangerous on the mainland even than at sea. The floods of rain that never fail to usher in the summer and autumn seasons frequently leave behind them landslides and inundations which take a heavy toll of life and precious farm land. Along the jagged coast-line the winds and currents are changeable, and perplexing to the mariner and fisher-folk, to whose arduous toil fresh dangers are added by the sunken and half-concealed rocks that so often line the shore. On the other hand, the splendour of a vegetation which includes more than half the known varieties of flowers, shrubs, and trees in the world, the varied beauties of the landscape, and an atmosphere of unusual clearness, unite to persuade the Japanese peasant that his land is one on which the "gods" are looking down with special favour. So it comes to pass that his outlook on that spirit world behind things seen is one of trust and hope, of reverence, and often of affection rather than of repulsion and dread. And we do not wonder, therefore, that on every attainable lofty mountain peak, by each lake and cascade—indeed, at whatever spot excites the imagination of the beholder by its beauty or its suggestion of power—there is almost certain to be found a shrine set up to the *genius loci*.

While two-thirds of the cultivated land is occupied by the rice-crops, three-quarters of the whole area of the country is composed of mountains, many of which rise to a height of upwards of 10,000 feet, and form a conspicuous part of every view. The rice-fields are held to be under the special care of Inari Sama, the Goddess of Food, in whose honour are reared many gaily-painted shrines, and at whose special festival,[1] early in the spring, intercessions are offered on behalf of a fruitful harvest later in the year. The attitude of the country-folk towards this divinity is mainly that of a sort of respectful familiarity and gratitude. For most of the mountains, however, there is manifested a reverential awe usually inclining towards fear. The sentiment often varies with the nature of the peak and its capacity for help or harm. Of the hundreds of volcanoes whose graceful forms rise in every part of the country, no less than fifty are active, and some of them prove a frequent source of disaster to life and property. On most mountains there are shrines to their guardian divinities. In two cases hereditary caretakers are attached to them, who make appropriate offerings to the divinity on important occasions.

I pointed out in the paper already alluded to in a footnote, that most of the popular festivals of rural Japan are those connected with the crops, on which in the long-run the chief prosperity of the country depends. A striking, though very little known, example of this came to my knowledge some years ago, the scene of which was a Buddhist temple called *Bukkyoji*, near the town of Tsuyama, in the province of Mimasaka in Central Japan. This festival is called *Go-ho*, and the title of the divinity in whose honour it is held is *Go-ho-zenjin*, i.e. "the good god who protects the ears of corn." Its object is to supplicate

[1] See DISCOVERY, Vol. II, No. 21, p. 229.

that being to protect the growing rice-crops from the depredations of the crows, and it is its connection with those birds that gives it some of its characteristic features. Into all the details of the weird and significant ceremonial we have not now time to enter, though they are the more striking from the fact that they are carried out at the present day quite close to a railway traversing the centre of the mainland of Japan.

The principal figure of the proceedings is a member of a family of farmers, in which the office of *Eri-dane*, or "Chosen Seed," has been hereditary for many generations. On July 16 (old style), at midnight, in the precincts of the temple, which are illuminated by huge torches of bamboo, a solemn invocation of the Sama, the Buddhist incarnation of the God of Crows, descends and proceeds to reincarnate himself in the person of the *Eri-dane.* This service lasts about half an hour, and at its conclusion the medium, now "possessed" by the spirit of the god, leaps up and dashes wildly about the enclosure, supported by a priest on either hand to prevent him from hurting himself by falling to the ground, or by colliding with the trees and walls surrounding the temple grounds. These exercises, relieved with intervals for rest, are prolonged for about an hour and a half, and the whole proceedings are watched by large crowds of peasantry from the surrounding countryside with mingled amusement and awe. At length the wander-

Fig. 1.—THE OLD AND THE NEW SIDE BY SIDE IN JAPAN.

The *torii* (sacred gateway) at the foot of Nantai-san, the holy peak above Lake Chuzenji, near Nikko, in Central Japan. Note the electric light, the telephone wire, and the English translation of the notice.

god takes place to the accompaniment of the blowing of conch-shells and the shrill rattling of the *shakujo*—the official staves of the Buddhist priests hung with rings of brass. Presently the *Eri-dane*, who has previously undergone a period of rigorous ascetic training, accompanied by frequent lustrations at a spring sacred to the *genius loci*, is led in and placed before the shrine. He is dressed in ceremonial garments and bound about with ropes of straw to prevent injury in the subsequent proceedings, and with his arms outstretched so as to resemble the wings of a hopping crow, is seated on a mat under a canopy of maple boughs. Fifteen young men stand round him and chant the office of the *Harai*, or service of supplication, in answer to which Fudo ing rushes of the *Eri-dane* lead him to the sacred water once more, this time under the direct guidance of the god, who now prompts him to apply it to his person. No sooner has it touched his face than he is instantly "dispossessed," and the spirit of the god now returns to the *gohei*—the sacred wand of *sakaki* wood, hung with strips of white paper, always found in Shinto shrines—in the temple on the mountain top. As the spectators depart they carry away with them fragments of the burnt-out torches and set them up in their fields as scarecrows of unique and universal efficacy.

Sir James Frazer has kindly pointed out to me the classical parallels to the foregoing in the worship of

Apollo Smintheus (" Mouse Apollo ") and of Dionysus Brassareus (" Fox Dionysus "). Such worship was probably addressed originally to the Lord of the Mice (himself a mouse) and to the Lord of the Foxes (himself a fox), in order to induce them to use their authority with their subjects in forbidding them to ravage the fields and vineyards of the suppliants. The worship of Baal-zebub (" Lord of the Flies ") was also, perhaps, similarly designed as a means of getting rid of plagues of flies, and the Greeks themselves are known to have adopted similar rites.

The ceremony of the *Go-ho* just described I found, upon investigation, to be connected with another strange cult, of wider scope and more elaborate ritual, known as *Kami-oroshi*. This is mainly practised by the most popular of those pilgrim clubs whose chief object is to seek spiritual enlightenment and, incidentally, certain material benefit, by the ascent of those sacred mountains which are held to possess special sanctity and to afford the closest opportunities of personal intercourse with the invisible powers dwelling on their summits. *Kami-oroshi* means " bringing down the god " and refers to the rite in its general aspect, while *Kangakari* (" causing the god to rest ") refers rather to the climax of the ceremony, the point at which the god is believed to have actually taken up his temporary abode in the person of the chosen " medium," through whom he is now about to communicate with those who have come to seek his aid. Little is known to the outside world of these " mysteries," the ritual and psychology of which provide a study of exceeding interest and of some scientific importance. The limits of the present paper, however, only permit of a brief reference to the main features of the practice itself, based upon the actual experiences of the writer on the spot.

FIG. 2.—AT THE DOOR OF THE SACRED SHRINE ON THE TOP OF FUJIYAMA.
The original shrine was first built 1,100 years ago. The man on the right with the white fillet round his head is the *Kannushi*—" Guardian of the God "—of the mountain.

The pilgrim clubs are known as *Koju*, and their ascetic members are called *Gyoja*. The Mecca or, rather, the Delphi, of their cult is the great extinct volcanic peak of Ontake-san (*san* means mountain), which lies to the north of the famous Nakasendo, " the inner mountain road," in Central Japan. The Nakasendo railway line also now passes within a few miles of the southern base of the mountain, and affords easy access for the numerous pilgrim bands who throng its slopes during the short climbing season of midsummer, when alone it is the goal of their journeyings.

The first introduction of the writer to the " séance " itself was on the summit of Ontake-san some years ago. Concealed behind the topmost shrine, a party of white-robed *gyoja* sat in Indian file facing the member of the band acting as the medium (*nakaza*—" seat between ") between themselves and the gods they had come to consult. At their head and facing him was one who, under the title of *maeza* (" seat before "), played the part of precentor and spokesman on behalf of the rest. The *nakaza*, with closed eyes,

sat silent and still, holding between the palms of his outstretched hands the sacred *gohei*, while the rest broke out into a subdued *Harai* addressed to the

FIG. 3.—FUJI-SAN THROUGH THE PINE-TREES ABOVE THE LAKE OF SHOJI.

mountain divinities of Ontake. Soon the face of the medium assumed a livid hue, unearthly gaspings issued from his throat, and the *gohei* now began to tremble violently in his grasp. His eyes turned upwards in their sockets until only half of the iris was visible, and a series of convulsive jerks at length brought the *gohei* to a standstill above his forehead—the god had come down upon it. Thereupon the *maeza*, bowing low towards the medium until his forehead touched the ground, reverently inquired what might be the "honourable name of the august visitor" whose presence had now replaced the personality of the *nakaza*. In a hoarse whisper came the answer, "I am Fukan Reijin"—this being the posthumous title of the canonised mountaineer who, in a dim and distant past, had made the first ascent of Ontake-san, and in whose honour, at that precise moment, a solemn festival commemorating it was being held at the ancient shrine at the mountain foot nearly 10,000 feet below.

As soon as the *maeza* heard the name, he began to prefer the requests of those pilgrims who had boons to crave. They were so simple that one wondered they should have been accompanied with so much reverence and mystery: "What sort of weather shall we be granted on our homeward way from the holy mountain?" "What about the health of those we have left at home?" "Will business prosper during the coming year?" and so forth. In a low voice the medium pronounced the replies the god saw fit to make, all quite orthodox in their oracular vagueness. When all the questions had been suitably dealt with, the medium lowered the *gohei* in token that the god had departed from his temporary abode, and that he was "coming to himself" again. The *maeza* then arose and with well-meant but necessary vigour fell to pounding and kneading the body and limbs of the medium, so stiff and rigid had they become in his cataleptic trance. Presently he came to, and then the party proceeded on their way, having taken no more notice of my presence than of the stocks and stones around them.

Later in the day, on our way down the mountain, I asked of the *sendachi*—the leader of another band of *gyoja*—the reason of the white clothes always worn by them on these pilgrimages. His explanation is deserving of record: "Unless we are striving to do right with our hands and to think right thoughts in our hearts, the gods will not commune with us nor answer our prayers; these white garments, therefore, are the symbol of the purity we seek." The words vividly recalled the Psalmist's own pronouncement: "Who shall ascend into the Hill of the Lord, or who shall rise up into His Holy Place? Even he that hath clean hands and a pure heart."

Among the Oracles of the ancient Shinto shrine of Kasuga, near Nara, the god declares: "We will refuse to enter the house of the depraved and miserly. . . . Hear, all men! If ye desire the help of the gods, put away pride. Even a hair of pride shuts ye off from the gods as if it were a great cloud."

To the Divinity of Fuji is ascribed a similar exhortation: "Ye men of mine! Shun desire. If ye shun desire, ye will ascend to a level with the gods. Every little yielding to anxiety is a step away from the natural heart of man. If anyone leaves the natural heart of man, he becomes a beast."

Mingled with all the reverence, admiration, and love cherished by the Japanese towards the idolised form of Fuji-san, there is nevertheless an element of awe which, though seldom outwardly manifested, is very real. A curious instance of this was experienced some years ago by the writer and two Cambridge friends who were anxious to make the ascent at an unorthodox season, while the mountain was still wearing its dazzling mantle of hitherto untrodden snow. The village fathers, the local police, and the priests of the ancient shrine of Omiya, at the base of the peak, the most important of the formal starting-

points for the ascent, earnestly warned us against the attempt. "For," they suggested, "the goddess of the mountain is not at home to visitors before the official *Yama-biraki* (mountain-opening), in the middle of July," and with dire forebodings we were warned to "look out for squalls" if we persisted.

No sooner had we reached our bivouac in the forest on the edge of the snow-line than a typhoon burst over the mountain and kept us prisoners for three days. At length, on a cloudless morning we were set free and reached the summit in a climb of seven hours, deserted by all our coolies save one. Traversing the peak we descended on the opposite side to Gotemba, so that our friends of Omiya saw us no more. A week or two later, the leading Japanese newspaper in Tokyo came out with the following account of a terrible disaster: "The foreigners who recently started to ascend Fuji with four coolies have not since been heard of . . . they were urged to postpone the attempt, but they were determined to go. As they have not since been heard of, it is feared they have either succumbed to the fury of the gale, or died of starvation. Their nationality is unknown, but it is surmised that they are British for the reason that the people of that nation like to do that which is distasteful to them and glory in their vigour."

A possible explanation of the fear of vengeance on the part of the offended divinity of the mountain is suggested by the name "Fuji," which is probably derived either from the Ainu word *push*, "to burst forth," or from "Huchi," the name of the Ainu Goddess of Fire. Other place-names in the neighbourhood are also of Ainu origin and take one back to the days when, before they were driven northwards by invaders, those hairy aborigines dwelt at the foot of the greatest mountain in Japan and, watching its fiery activities with mingled awe and terror, made it the supreme object of their worship.

The chastisement of sacrilegious and unwelcome visitors as a token of the resentment of the spirits of the greater peaks is at times a forcible proof, in the eyes of the rustics living beneath their shadows, of the need of care in approaching their sacred precincts.

On the mountain of Hodaka-yama, in the Northern Alps, this was brought home to me with painful force. After making the first ascent by a European traveller, I was attacked on the way down through the depths of a gloomy forest, and badly stung, by angry inhabitants of a wasps' nest. Later in the evening, as I was drying my wet garments at the camp fire, a Japanese traveller also bivouacking there approached me with a request to show him the wounded spots on my "honourable body." Presently I turned round and found him engaged in making a series of mesmeric passes over them. He then arose and, standing in the doorway of the hut, clapped his hands and bowed his head in supplication to the spirit of the mountain. He then approached me once more and in a hoarse whisper exclaimed, "This is *majinai* ("magic"): you will be all right in the morning." He went on to explain that I—a sacrilegious foreigner—was the object of the resentment of the offended divinity, and that what looked and no doubt felt like wasps were but the embodied spirits of her retribution. This goddess is held to possess special power over wind and storm, and the rite of *amagoi*, ("praying for rain") in times of drought, is believed to be unusually efficacious when performed at the little shrine in her honour at the mountain foot.

It will be gathered from the foregoing illustrations that it is as true of the rural Japanese as it was of the ancient Greeks that "around their mountains more than all other spots did mythology most closely gather as the home of the gods and as the most frequent scene of their intercourse with men." [1] And just as the Chinese pilgrim to-day wends his toilsome way to the summit of the precipices of Mount Omi,

FIG. 4.—A PILGRIM ON THE SUMMIT OF FUJI-SAN (12,400 FEET) WORSHIPPING THE RISING SUN FROM THE PACIFIC, BEYOND THE SEA OF CLOUDS.

in the province of Such'uan, where the pure in heart are promised the vision of the "Light of the Glory of

[1] *Lectures on the Geography of Greece*, by H. F. Tozer. (John Murray.)

Buddha," so, in the hut of the Japanese *gyoja* on Togakushi-san in Shinshiu, I was assured that the mountaineer with sufficient faith, who should be there at early dawn, would behold Amida Buddha riding on a cloud of many gorgeous hues.

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Biology in Shakespeare I.

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Shakespeare has been called a complete intellect; and this would be justified if one contemplated only the profundity of his knowledge of human nature in all ages and at all social levels. Nothing that has ever passed through the human mind seems to have escaped him. It would be easy to draw up a catalogue of the mistakes and anachronisms of Shakespeare; but were the list ten times the length it is, they would be completely atoned for by the penetration of his instinct and its unerringness wherever the workings of the human mind are concerned.

If in biological science Shakespeare did repeat the mistaken notions current in his day, it may be none the less interesting to examine some of these in detail, and by the light of our modern knowledge of life endeavour to understand just what phenomena they were that engaged Shakespeare's attention.

The question arises, did Shakespeare know the physiology current in his day, and, if so, did he give expression to what was generally believed, or, as regards the matter of that science as in so much else, did he transcend the views current in his time and flash forth beyond them in prophetic prevision?

It happens that Shakespeare lived at a time when most momentous discoveries were taking place in physiology. Shakespeare and the world-renowned Dr. William Harvey, the discoverer of the circulation of the blood, were contemporaries for some thirty-eight years of their lives, for Shakespeare was born in 1564 and died in 1616, while Harvey was born in 1578 and died in 1657. Harvey was thirty-eight years old when Shakespeare died. By 1616 Harvey had not, however, announced his epoch-making discovery which was published in 1628, and even then not in England, but at Frankfort-on-the-Main.

It is rather curious to remember that the earliest writings of Harvey known to contain any description of the circulation of the blood, in which the heart is regarded as the central power for it, are dated 1616. These are none other than Harvey's manuscript notes for his Lumleian lectures, the first of which he delivered at the College of Physicians on April 16, 1616. These precious leaves accidentally discovered have been bound together and now repose in the British Museum.

Seeing that Shakespeare died on April 23, 1616, it is at once apparent that he could have known nothing of the Harveian views on the circulation of the blood, the starting point of modern physiology, for the *Exercitatio de motu cordis et sanguinis in animalibus* was not printed for twelve years after that date. Thus Shakespeare could not have known of his great contemporary's discovery because he died twelve years too soon. Neither could Shakespeare's son-in-law, Dr. Hall, of Stratford-on-Avon, have told him of it, as some have thoughtlessly suggested he might, since, for one thing, Hall married Shakespeare's daughter as early as 1607. Some uncritical writers have assumed that Shakespeare must have known of the circulation of the blood because he was a contemporary of Harvey. But the two great men may never have met. Harvey was a student of medicine at Padua from 1598 to 1602, the very time when Shakespeare was at the height of his activity.

Even if they did meet, the young doctor was not in the least likely to discuss with the great actor his revolutionary view of a matter of pure physiology. If Harvey discussed so technical a subject before he gave it to the world, it would have been exclusively with his medical brethren. We should expect from *a priori* considerations, without examining Shakespeare's works at all, that their author was not acquainted with the new views concerning the circulation of the blood. A close examination of these writings confirms this opinion in the fullest manner.

If Shakespeare, then, was not acquainted with the Harveian doctrine, what view did he know? The reply is that he evidently held the views which had been taught in the medical schools of Europe for 1,400 years —the views of Claudius Galen.

The Galenical notions of the movement of the blood can be understood only after still earlier views are comprehended. The distinction between arteries and veins was made before even the time of Aristotle. Shortly after the death of Aristotle, Erasistratus (300 B.C.), of Alexandria, thought that blood for the nourishing of the body travelled up and down the veins only; whereas in the arteries "vital spirits" alone were found. Erasistratus thought that arteries during life did not

contain blood because after death arteries are found to be empty. By vivisectional methods Galen made the discovery that the arteries contain blood during life. According to him the veins contained " crude " blood, the arteries pure or spirituous blood, that is, blood mixed with vital spirits. The Galenical doctrine of spirits, on which learned Europe subsisted for a millennium, was somewhat complicated as it recognised no less than three different kinds related somewhat in the following manner. The food in the intestine was supposed to be absorbed into the liver, where it was elaborated so as to be possessed of " natural " spirits. This crude blood then passed to the right side of the heart, into which all the veins of the body opened. This blood, still crude, was supposed to nourish the body by passing up and down the veins as by the ebb and flow of a tide. Its " natural spirits " in modern terminology would be equivalent to " powers of nourishing." Most of this crude blood was supposed to percolate through invisible pores in the septum or partition that divides the right from the left ventricle of the heart, only a little of it going round by the pulmonary artery to nourish the lungs. In the left ventricle the blood was supposed to be mixed with air inhaled in the act of breathing. Aristotle taught that the inspired air was needed to cool the " innate heat " of the heart ; Galen adopted this view and added another result of the mixing of blood and air, namely, the elaboration of " vital spirits." The great arterial vessel of the body, the aorta, arises from the left ventricle, so that blood plus vital spirits passed by the arteries to the tissues and organs to confer on them the powers of performing their specific functions. The vital spirits, therefore, promoted functional activity of the tissues. Finally, said Galen, blood plus vital spirits is carried to the brain—an organ which Aristotle declared was cold and bloodless—and there becomes the seat of the production of a third order of spirit—the "animal." This production of animal spirits was supposed to go on in the ventricles or cavities of the brain. These animal spirits, which as a term survive only in colloquial English, were to Galen what nerve-impulses are to us ; but they were a great deal more, for they were the very instrument of the soul itself. The word " animal " does not in this connection mean " belonging to a beast " ; it means pertaining to the soul or *anima*, the Latin equivalent for the Greek *psyche*, the life or soul. The full Latin expression is *spiritus animalis*.

The animal spirits of Galen are in modern language equivalent to consciousness generally, and to motor and sensory innervations as well. Such is a simplified account of the doctrine of spirits which was the orthodox medical teaching as late as during the lifetime of Shakespeare. It persisted in common parlance until long afterwards, for in the reign of Queen Anne (1708) the *Daily Courant* advertised a perfume as efficacious because " it increases all the spirits, natural, vital and animal," which is quite in the Galenical order.

Let us now examine the passages in Shakespeare's writings in which mention is made in some sort or other of blood, blood-vessels, or heart.

In *Love's Labour's Lost* (Act IV, Sc. 3) we have the expression : " The nimble spirits in the arteries," a direct echo of the Aristotelean-Galenical teaching.

The veins are mentioned much more frequently. In *King John* (Act III, Sc. 3) we find the expression " blood . . . runs tickling up and down the veins." The interest in this is, of course, the phrase " up and down," which is precisely what was taught as regards blood in veins before the unidirectional flow of blood was demonstrated by Harvey. The pre-Harveian notion of a tide, that is, an up and a down, a to and fro movement in the veins is exactly reproduced in this passage. In the same play we find the line

> " Whiles warm life plays in that infant's veins "—

and are at once reminded of the exceedingly old belief that the life was pre-eminently in the blood. Not only do we have in the Hebrew Scriptures the phrase, " for the blood is the life," but also find the same idea in the Hippocratic writings. The Hippocratic writer based his belief on the familiar observation that, when the blood has run out of the body of a slaughtered animal, the animal dies.

Once more in the same play we have this idea quite distinctly put (*King John*, Act V, Sc. 7) : " The life of all his blood is touched corruptibly."

Possibly the best-known passage in which the movement of the blood is alluded to is in *Coriolanus* (Act I, Sc. 1), where Menenius Agrippa, a friend of Coriolanus, speaking of the belly, says :

> " True it is . . . that I receive the general food at first
> Which you do live upon, and fit it is,
> Because I am the storehouse and the shop
> Of the whole body : But if you do remember,
> I send it through the rivers of your blood
> Even to the court, the heart—to the seat o' the brain,
> And through the cranks and offices of man,
> The strongest nerves and small inferior veins
> From me receive that natural competency
> Whereby they live."

Now, while it is quite absurd to see in this not only modern physiology but a prophetic vision of Harvey's discovery, the passage is not wanting in biological interest. The general idea of the abdominal viscera receiving food and working it up into the blood destined for the nourishment of the whole body, including the nerves and brain, is involved in this passage and so far is physiologically correct. But undoubtedly it is

the phrase "rivers of your blood" that should arrest us, for, if literally accepted, it does indicate the notion of a flow in one direction only. The flow of a river is the very opposite of a tidal flow.

To insist, however, that, because Shakespeare used the expression "rivers of blood," he actually foresaw the discovery of the circulation, is to read a great deal too much into this passage; possibly he meant no more by "rivers" than if he had said "streams." If we had none other than this passage to go upon, we might admit that Shakespeare had before him the Harveian notion of a flow only in one direction; but in the light of what he writes in Act V, Sc. 1, of the same play—

"The veins unfilled, our blood is cold, and then
We pout upon the morning, are unapt
To give or to forgive; but when we have stuffed
These pipes and these conveyances of our blood
With wine and feeding, we have suppler souls
Than in our priest-like fasts"—

we cannot but believe that Shakespeare held no view other than the Galenical one of his own day, namely, that the veins, not the arteries, convey the nourishment to all parts of the body. The revivifying effect of alcohol taken with food is fully appreciated in this passage.

That distinguished man of science, Steno the Dane, was violently criticised for his irreverence in asserting that the heart—the seat of the soul—was in its essence none other than a common muscle.

Shakespeare seems to have had an inkling of the pre-eminence of the beating organ in the chest; he knew not only fairly accurately where the heart-beat is, but how emotions directly affect it, as when Macbeth exclaims,

"Whose horrid image doth unfix my hair,
And make my seated heart knock at my ribs."

One of Shakespeare's allusions to blood reaching the heart has been made a good deal of by certain writers on the history of physiological discovery. The passage is in Julius Cæsar (Act II, Sc. 1) where Brutus exclaims,

"You are my true and honourable wife,
As dear to me as are the ruddy drops
That visit my sad heart."

All that this asserts could be known from observing slaughtered animals, namely, that blood is in the heart; and yet some writers have gone so far as to maintain that Shakespeare anticipated Harvey in the matter of the dicovery of the circulation. This is excess of hero-worship.

There is, however, quite a striking passage in *Measure for Measure* (Act IV, Sc. 3), where the heart is mentioned in a new connection:

Lucio: "O Pretty Isabella; I am pale at mine heart to see thine eyes so red"

The thought in Shakespeare's mind was probably that the emotion of sorrow or sympathy blanches the heart in the same way that some emotions blanch the skin of the face. While the literal physiology of this is incorrect, there is the recognition of the important effect of psychical states on the condition of the heart.

(*To be continued*)

Reviews of Books

NEW REVELATIONS OF BYRON'S PERSONALITY

Lord Byron's Correspondence, chiefly with Lady Melbourne, Mr. Hobhouse, The Hon. Douglas Kinnaird, and P. B. Shelley. With Portraits. Edited by John Murray, C.V.O. In two volumes. (John Murray, 25s.)

The French Revolution and the subsequent Napoleonic Wars threw a strange assortment of men to the surface not only in the world of politics, but also in literature. The events of these years stirred men to their depths, and, so far as our poets were concerned, drove them out of the "polite society" of Bath and the "coffee taverns" of London, to wander again through the green fields of England, or across the Continent, and made them face the realities of life, not in a library chair, but in the open world and amongst other human beings. As the nineteenth century wore on poets began to return to London clubs and drawing-rooms, and we find Tennyson, the author of *The Idylls of the King*, reigning as the literary lion in the place of Byron, the author of *Don Juan*. Tranquillity flows through Tennyson's works, even through the most passionate stanzas of *Maud*, but a blast of passion and strong emotion surges through Byron's poems.

Byron appealed to an age of unrest and violent contrasts. His character was, indeed, a strange blend of opposing tendencies. After his death our Victorian ancestors exaggerated all his worst qualities, and handed on to us the picture of a haughty, sneering aristocrat, who lived the life of a depraved and selfish debauchee, and wrote immoral poems which no young person should be allowed to read. That is only a one-sided picture, and we believe that these two new volumes of his letters will help to shed a more kindly light on his life and personality.

There was something both of the *Dr. Jekyll* and of the *Mr. Hyde* in Byron's make-up, though he never reached such extremes of kindness or of cruelty. It is impossible to put a good reflection on such matters as his treatment of Clare Clairmont, the attitude he adopted towards Leigh Hunt and his family on their arrival in Italy, his readiness to believe slanders about his friend Shelley (see vol. ii, p. 183), his numerous dislikings of people and his habit of loudly voicing them. These seem to us more inexcusable than any of his *amours*, for there is an inhumanity about them. Yet, taking the man with all the handicaps with

which he entered on life—his violent-tempered mother, his admission to the peerage when quite a boy, his extreme handsomeness, and, most important of all, the deformed foot which denied an athletic body its full outlet of energy—we should rather be surprised at the fine and more generous qualities which he displayed. His deep and lasting friendship with Hobhouse, his affection for his old servant, Fletcher, his generosity in lending and giving money, his championship of the cause of Greek independence (resulting in his death)—these were some of the truest things in his life. But we must let the new letters speak for themselves.

The present collection belonged to John Cam Hobhouse, Byron's great friend already referred to. At his death they passed into the hands of his daughter, Lady Dorchester. Lady Dorchester died in 1914 without having published them, and bequeathed them to Mr. Murray, who has now edited them. In the first volume we have the poet's letters to Hobhouse, written during his travels in Greece and Turkey, from 1808, when he was twenty, to 1811, and soon after his return to England, and his letters to Lady Melbourne, covering the period 1812—the year in which he " woke one morning and found himself famous " after his first speech in the House of Lords and the publication of the first two cantos of *Childe Harold*—to the end of the first three months of his married life, in April 1815. The second volume, by far the most interesting of the two, covers the period of his exile in Italy, 1816–1823, and his expedition to Greece, 1823–1824. It contains correspondence with various persons in England, chiefly Hobhouse and another friend, Kinnaird, and a large number of valuable letters, as we shall see later, written to him by Byron's fellow-exile in Italy and contemporary poet, Shelley.

On account of space we must content ourselves with drawing a few extracts out of the two volumes. In August 1810 Byron was staying at the convent in Athens, and in a letter to Hobhouse gives a charming pen-picture, touched with a kindly irony, of the Abbot's young pupils, " my only associates " : " Of this goodly company three are Catholics, and three are Greeks, which schismatics I have already set a boxing to the great amusement of the Father, who rejoices to see the Catholics conquer. . . . We have nothing but riot from noon to night. The first time I mingled with these sylphs, after about two minutes' reconnoitring, the amiable Signor Barthelemi, without any previous notice, seated himself by me, and after observing by way of compliment that my ' Signoria ' was the ' piu bello ' of his English acquaintance, saluted me on the left cheek, for which freedom being reproved by Giuseppè, who very properly informed him that I was ' μεγάλος ' ; he told him I was his ' φίλος,' and ' by his beard ' he would do so again, adding, in reply to the question ' διὰ τὶ ἀσπάσετε ? ' you see he laughs, as in good truth I did heartily.

" But my friend, as you may easily imagine, is Nicolo, who, by-the-bye, is my Italian master, and we are already very philosophical. I am his ' Padrone ' and his ' amico,' and the Lord knows what besides. It is about two hours since, that, after informing me he was most desirous to follow *him* (that is me) over the world, he concluded by telling me it was proper for us not only to live but ' morire insieme.' . . .

" I am awakened in the morning by those imps shouting ' Venite abasso,' and the friar gravely observes it is ' bisogno bastonare ' everybody before the studies can possibly commence."

Hobhouse had accompanied Byron during the early part of these travels. When Hobhouse left for England, he owed Byron £818. It is typical of the latter's generosity that he writes to his friend from Malta in May 1811, though he did not at the time " know where to raise a shilling " himself, that " with regard to our account, don't think of it, or let your father think of it, for I will not hear of it till you are in a state to pay it as easily as so many shillings. I have fifty resources, and besides my person is parliamentary—pay your tradesmen—I am none."

Byron returned to England in July 1811. By 1813 he had reached the height of his fame and popularity in London Society. But he had, as the editor tells us, become " entangled in a social circle whose code of morality was lax, even judged by the standards of the Regency period." He began to entertain a genuine desire to meet and marry a woman who would " govern him." Unfortunately his great confidante of these years, Lady Melbourne, so encouraged his interest in her niece, Miss Milbanke, that his friendship with this lady, far too austere and cold for him, was manufactured into a semblance of love. It is regrettable that Lady Melbourne, who had hitherto exercised an influence all for the good upon Byron, should have ended in effecting a match that was to ruin his life in England and embitter, even more than before, his highly sensitive character. As to Annabella, she herself feared that " he was not the person whom she ought to select as her guide, support, and example on earth with a view to Immortality " ! And as to Byron, we find him writing of Annabella before their marriage in strains such as these : " She seems to have more feeling than we imagine ; but is the most *silent* woman I have ever encountered ; which perplexes me extremely "; " she is, as you know, a perfectly good person " ; " Do you know I have grave doubts if this will be a marriage now ? Her disposition is the very reverse to our imaginings. She is overrun with fine feelings, scruples about herself and her disposition (I suppose, in fact, she means mine), and to crown all is taken ill every three days with I know not what " ; (this last, if you please, less than two months before their marriage). And what could be expected of a marriage when the husband writes during the honeymoon that " I have great hopes this match will turn out well " ?

The match did not turn out at all well, and Byron left England on April 25, 1816, pursued by the clamourings of his debtors and the censures of a society which was prudishly moral on the surface, whatever it was underneath. Arriving in Switzerland some months later, he met Shelley for the first time. Shelley, the younger poet, though never one of Byron's most intimate friends, exercised a strong and good influence on his life and poetry both there, and later on in Italy, and his letters to Byron, here first published, are of great interest. No two characters

could be so diverse as these two men's— a fact which is vividly illustrated by the juxtaposition of their letters in the second volume. It is, indeed, a peculiar sensation to turn over a page of high idealism, or some description of natural beauty expressed in the clear, suave prose of which the lyric poet was a master, and to be plunged on the next into a whirlwind of hot-blooded emotions, irony, wit, and vividly told *raconte* produced by the brilliant satirist.

The centenary of Shelley's death, off Lerici in the Gulf of Spezia, takes place in July of this year. The mystery attaching to the swamping of his boat in a sudden storm has never been completely cleared up. But a letter in this volume written by Byron to his bankers in September of the same year lends additional weight to the belief that the boat was rammed during the storm by a Genoese fishing felucca in the belief that Byron was on board with £50. "The extreme liberality of *Mr. Shelley's* disposition," Byron remarks, "generally left him in arrear, and the day before he was lost he borrowed of me fifty pounds which were on board in cash when the boat went down." In November 1875 Trelawny's [1] daughter wrote to him from Rome concerning a death-bed confession made at Spezia by an old sailor," that he was one of the crew that ran down the boat containing Shelley and Williams, which was done under the impression that the rich 'milord Byron' was on board with lots of money." The letter confirmed Trelawny in his suspicions, and most biographers of Shelley have adopted this explanation of the tragedy. What still remains uncertain is whether there was any motive of revenge as well as greed. Byron had had several quarrels just before the disaster, and according to the old fisherman "they did not intend to sink the boat, but to board her and murder Byron."

Leigh Hunt,[2] a well-known contemporary literary critic, to whom Byron usually showed the harder side of his character, said that in his cups he became a changed person, and that it was then that he felt he was talking with the "true Byron"—a man only too desirous to give and receive an intense degree of sympathy. That softer side emerges often in these letters, where in writing to his most intimate friends we again encounter the mind of the "true Byron." As we have already noted, his deformed foot accounted more than anything else for the cynical twist in his mind. Like Pope, the satirical poet of the eighteenth century, he suffered from what our modern experts would call "dwarf psychology," though there is of course no doubt who was the greater man and the greater poet of the two.

E. L.

Ocean Research and the Great Fisheries. By G. C. L. Howell, M.A. (Clarendon Press, Oxford, 18*s.*)

Recently a leading Fish Trades Journal assured us that "the man who produces a really thoughtful work on the economics and the future of the fishing industry will deserve well of the nation." Presumably this book has been written in reply to that suggestion. Mr. Howell's qualifications for writing on our Sea Fisheries were obtained when he acted as Director of Fisheries in the Panjab; his knowledge of Ocean Research is based on a more slender foundation, since he is devoid of scientific training. Mr. Howell is an "expert" member of the Advisory Committee on Fishery Research to the Development Commissioners, and a member of the Freshwater Fisheries sub-committee to the same body. His book contains thirty-two chapters and ninety notes of interrogation, on the average about three to the chapter. The notes of exclamation are nearly as numerous, and the book is by no means free from minor errors and misprints. It purports to give an account of the natural history and economics of our principal marine fish.

In 1921 Lemon Soles to the weight of 31,714 cwts. and value of £153,023 were landed in England and Wales. Catfish and Dabs, which are more abundant and valuable than the Lemon Sole, are not mentioned by Mr. Howell. A chapter of barely four pages is devoted to the organisation of Ocean Research, another of less than five pages to the collection of fishery statistics, and there is a final chapter of fourteen pages on the "Small Game" of the sea.

Two extracts will suffice to give an idea of the author's literary style:

"Why do some herrings contract infant marriages, while others are still bachelors and spinsters in austere middle age?" (pp. 173–4).

"The Norwegians—who are the 'sea-daddies of the world'—can be relied upon always to 'think big'" (p. 179).

The only redeeming feature of the book is the excellence of the illustrations, the best of which appear to have been prepared by the scientific men engaged by the Local Sea Fisheries Committees, bodies for which on more than one occasion Mr. Howell has publicly expressed his contempt.

J. T. J.

East Carelia and Kola Lapmark. Described by Finnish scientists and philologists. Edited by Th. Homén. Illustrations and Maps. (Longmans, Green & Co., 21*s.*)

The original of this work appeared in Finnish in 1918, and the present volume is a translation of the later Swedish edition. It comprises chapters on all aspects of the geography, history, and social conditions of that part of Arctic Russia which lies south of the Arctic Ocean, between the White Sea and the frontier of Finland. The population in that region, especially in the Kola peninsula or Kola Lapmark, is far from dense, and does not enjoy a high degree of prosperity, due largely to conditions beyond the control of man. The Carelians, who have given their name to the southern and more low-lying part of this region, are a branch of the Finnish race, and are found also in Eastern Finland. Their language is closely related to Finnish. In Carelia they form the majority of the inhabitants, except along the coast and in the White Sea ports, where Russians preponderate. But in Kola Lapmark they are in a distinct minority, except, perhaps, in

[1] See *Records of Shelley, Byron and the Author.* Pp. 112-113. (George Routledge & Sons, Ltd.)

[2] See *The Autobiography of Leigh Hunt.* Vol. II. (Constable & Co., Ltd.)

that part ceded to Finland by the Treaty of Dorpat, 1920. A movement for autonomy in Carelia followed the Russian Soviet revolution and, fanned by Finnish sympathy, now takes the form of a demand for union with Finland. The main arguments against this wish, apart from the opposition of the Russian Soviet, are, first, that the minority of Finns and Carelians in the Kola peninsula would not justify its inclusion in any cession of territory, and the result, if Carelia were ceded, would be a detached portion of Russian territory; and, secondly, that the loss of Carelia would cut the important Murman railway which affords Russia access to an ice-free port on the Arctic coast. The volume is a genuine contribution to knowledge, and the authors leave facts to speak for themselves, laying little stress on the propagandist side of their task. R. N. R. B.

THE EVOLUTION OF THE EARTH

Earth Evolution and its Facial Expression. By WILLIAM HERBERT HOBBS. (Macmillan & Co., Ltd., 15*s.*)

This book embodies the views of the author, a professor in the University of Michigan, on the evolution of the earth and its facial expression; it is a vigorous exposition that will interest not only the geologist, to whom it is primarily addressed, but also the general reader who is interested in this subject. Professor Hobbs gives a clear and useful summary of the evidence that has accumulated against the now almost abandoned nebular hypothesis of the origin of the world, and points out how foolish people were ever to have believed in it. He is against any theory which describes the interior of the earth as molten; he disbelieves, as do many others, in the relative permanence of the great oceans, and dismisses summarily the idea that the presence of radio-active substances compensates to any degree for the loss of heat from the earth by radiation into space.

He believes that the earth is in process of shrinking from the form of a sphere (in which the ratio of volume to enclosing surface is a maximum) to that of a regular tetrahedron, in which this ratio is a minimum, and the most valuable part of the book contains an exposition of this hypothesis. The author believes also that the age of the earth has been quite unnecessarily exaggerated; he thinks that twenty-four million years is sufficient to account for all known geological phenomena.

The general reader cannot but admire the freshness of outlook and the originality of some of Professor Hobbs' ideas, even when possibly he is riding off at a tangent. He is against conventionality of thought on geological subjects, or bowing the knee to the opinions of great men. As an example:

" Anyone who has examined into the history of the theories of earth evolution must have been astounded to observe the manner in which the unique and the difficultly explainable has been made to take the place of the common and the natural in deriving the framework of these theories. The part of the accidental and fortuitous has been by no means a small one in guiding the thoughts and the speculations of those who have dealt with the fundamental theories of the universe.

" The unique rings of Saturn gave shape to the nebular hypothesis. The almost unique properties of water near its temperature of congelation was largely responsible for the idea of a molten earth core, long the orthodox doctrine of geological science. The unique rigid mass of Bohemia near the arcs of Europe and that of India near those of Asia largely determined the form of the Suess conception of arcuate mountains. . . . Those theories which have come to receive general support . . . have quite generally owed their success to the unusual prestige of their promulgators by reason of some outstanding piece of investigation, though this may have been in a different field from that of the theory that has been added to the body of orthodox doctrine. This was notably true of Laplace and his great work, the *Méchanique Céleste*, in which the famous nebular hypothesis is contained as an apparently little considered afterthought appearing as an appendix. . . . Once accepted by the leaders of thought, the position of a new theory is one peculiarly immune from attack. If its rise to prominence is in any way sensational, the theory becomes, as it were, in a measure canonised and clothed with a quality of sanctity. Attacks upon it are welcomed as little by the scientific profession as they are by the promulgators of the theory. The Einstein theory of relativity, which is just now in the saddle, receives extravagant praise, and the voices of those who point out its fallacies are lost in the thunder of applause."

But at times Professor Hobbs is much less illuminating and convincing. He is greatly enamoured of the idea that the span of geological time has been greatly overestimated, and this, he believes, is largely due to "the accident of location of those who have studied geological processes. Had the early universities been located within the Pacific area (where earthquakes are frequent) rather than about the Atlantic; had geologists made their investigations within those belts of the earth which are undergoing rapid change—the orthodox view concerning the time which has been necessary for the accomplishment of the past geological changes would have been found to be a fraction only of that which it is now supposed to be."

But what about the opposing evidence, that of the physicists, which demands an age for the earth forty times greater than Professor Hobbs' estimate? He does not discuss it, and in the only place where he mentions it, he writes as though he did not properly understand it. It is well to show how bees in men's bonnets and the accidents of environment have twisted grotesquely the truth that men have sought in the past, but views on geological or any other problems cannot be generally accepted if their author so patently neglects the conclusions of men now living. A. S. R.

BOOKS ON PSYCHOLOGY

The Care of the Adolescent Girl. By PHYLLIS BLANCHARD, Ph.D. (Kegan Paul, Trench, Trübner & Co., Ltd., 7*s.* 6*d.*)

The title of Dr. Blanchard's book does not give quite a fair idea of its scope, for it is not an elementary handbook of useful advice, but a study of the psychology of

the adolescent girl in particular, and a general review of the development of the sexual impulse as a preoccupying influence in the life of man, looking forward finally to a time when it shall become less fulminatingly masculine and, approaching the feminine ideal, shall irradiate a new and less competitive civilisation.

In the *crise d'adolescence* of the girl the author sees a conflict between the racial instincts on the one hand, urging her towards the goal of womanhood and the self-abnegation and sacrifice that it exacts, and, on the other, the egocentric impulse that demands a free expression for her personality; a conflict often biased by what Freud regards as the *causa causans* of it, the difficulty of breaking free from the infantile attachment to one of the parents. This seems a very reasonable view so far as it goes, but adolescence is a difficult time for boys as well as for girls, and one is inclined to look for an underlying factor common to both sexes. Jung and especially Nicoll have pointed out that at adolescence, as at other periods of transition, there is frequently a reluctance to adopt the new attitude towards life, to leave the old and known and to accept what is virtually a new personality. This seems to spring from a deep source of inhibition and to merit rather more consideration than the author has given it.

For the difficulties of a woman's life the author lays much blame upon man, who has exploited her innate tendency to renunciation and, when she endeavours to escape, has infected her with his ideals of power and domination. These arrows of criticism have been aimed at man, usually with more venom and less precision, tolerably frequently of late years, and this is no place to make an apologia for him, yet it may be ventured that the great wave of introversion that is affecting the psychology of the Western nations, and is possibly less marked on the other side of the Atlantic, is beginning to modify the "will to power" masculine type that Dr. Blanchard describes, and tending to diminish a little the mutual antagonism of the sexes.

One chapter is devoted to the practical question of education and the means of sublimating the primitive energy liberated at puberty, and at the same time providing a channel of self-expression, in literature, art, and social activity, and by more humanistic methods of teaching.

Dr. Blanchard writes a firm, clear prose, and her book should appeal to the general reader as well as to the specialist in education. F. A. H.

Morbid Fears and Compulsions. By PROFESSOR H. W. FRINK, M.D. (Kegan Paul, Trench, Trübner & Co., Ltd., 21s.)

Dr. Frink tells us in a foreword that the present volume is intended as a general introduction to a second one in which morbid fears and the compulsion neurosis will be discussed from a therapeutic and more technical standpoint. The title of the book does not, therefore, give a very fair idea of its scope, since more than half of it is devoted to an exposition of the doctrines of the Freudian school of psychology.

Dr. Frink writes primarily for the physician, and therefore tends to present psycho-analysis rather in its application to morbid psychology than as a method of investigating the human mind or as a system of philosophy; but the reader will find in the first part of the book what might be called a good working guide to the Freudian psychology; the more academic features are omitted and some of the later developments are not dealt with, but many misconceptions are cleared away and the author does good service in explaining what is *not* meant by the "Œdipus complex" and other much abused and misunderstood terms.

It is perhaps unfortunate that certain theories which are by no means self-evident are stated almost axiomatically, as when the author says that "the masochistic partial impulse furnishes the motive for obedience," and, a little later, "the primitive sexual curiosity thus becomes a desire for general knowledge," these instances are the more important since the principle to which they refer, namely, the evolution of the higher social instincts from the sexual impulse, is one of the points of Freud's teaching that has been most strongly criticised, and to present such a theory axiomatically is to give the impression, which reference to the original sources would show to be incorrect, that it is not supported by evidence. Such a method of presentation has the advantage of simplicity and seems to be common among the expositors of psycho-analysis, but it obscures the fact that Freud constructed his theories, tentatively for the most part, upon an accumulation of evidence, and it gives the impression that they have assumed a greater fixity and rigidity in the minds of his followers than is perhaps altogether warranted in view of the existence of alternative theories and explanations.

The later part of the book is of great value from the point of view of practical therapeutics, for it gives what is seldom possible in a textbook—a detailed analysis of two cases. The first case is especially useful, for in it the author demonstrates the important part played by non-sexual factors in the causation of a neurosis—factors that are admitted by the Freudian school to have their importance, but, as Dr. Putnam hints in a sympathetic but critical preface, are sometimes apt to escape recognition. F. A. H.

The Technique of Psycho-analysis. By DAVID FORSYTHE, M.D., D.Sc., F.R.C.P. (Kegan Paul, Trench, Trübner & Co., Ltd., 5s.)

The term "psycho-analysis" applies by right of priority to the methods employed by the Freudian school of psychology for investigating the mental processes and, if strictly used, it does not cover the theory and practice of those other schools of psychology that have developed out of the original teachings of Professor Freud. Dr. Forsythe's book is therefore, as its title implies, a description of the methods to be employed in putting the teachings of the Freudian school into practice.

It is written for those of the medical profession who are practising, or thinking of practising, psycho-analysis, and the latter are warned that they will find it neither easy nor lucrative. It naturally presupposes that the reader is already acquainted with the theoretical aspect of the subject.

Dr. Forsythe's long experience enables him to give valuable advice about the pitfalls and difficulties that may be encountered, but he does not exclude small practical details such as the arrangement of the consulting and waiting rooms and the hours of treatment.

For a small book it contains rather a large number of misprints, but these will doubtless be corrected in a later edition. F. A. H.

SHORTER NOTICES

Radiations from Slow Radium and Their Therapeutic Value. By JOHN B. KRAMER. (Baillière, Tindall & Cox, 12*s*. 6*d*.)

A nicely produced but pretentious book, containing several very inaccurate descriptions of simple scientific facts. Mr. Kramer's case is that impure (and therefore weak) radio-active preparations (for which he has invented the name Slow Radium) have a therapeutic value similar to that of pure radium, if applied in proper amount and for the proper time. This he supports with many facts, illustrations, and descriptions of cures. But since radium is radium, whether pure and strong or impure and "slow," this case needs no arguing; it is admitted; indeed, it is self-evident. If Mr. Kramer really understood radio-activity, he would not only have escaped falling nto several egregious errors relating to it; he would not have written this book.

Patents and Chemical Research. By H. E. POTTS, B.Sc. (Liverpool University Press, 8*s*. 6*d*.)

This subject is intimately described by one who is both a chemist and a patent-agent, and the book is primarily addressed to research chemists who have an interest in the commercial exploitation of their work. It is a plea for the closest co-operation between chemist and patent-agent. In making out his case, Mr. Potts has succeeded in writing an exceedingly interesting book, which all chemistry students attracted by the subject-matter of the title would do well to read; it is really an interesting talk about the whole subject, with apt illustrations, and without unnecessary technical or legal jargon.

Rays of Positive Electricity; and Their Application to Chemical Analysis. 2nd Edition. By SIR J. J. THOMSON, O.M., F.R.S. (Longmans, Green & Co. 16*s*.)

The Emission of Electricity from Hot Bodies. 2nd Edition. By O. W. RICHARDSON, D.Sc., F.R.S. (Longmans, Green & Co., 16*s*.)

These books, new editions in the series of Monographs on Physics edited by Sir Joseph Thomson and Dr. Frank Horton, give clear and up-to-date accounts of subjects which the authors themselves have been first in developing They are, of course, for advanced students only.

Sir Joseph Thomson's book includes an account and a discussion of Dr. Aston's recent work. The plates in the appendix are excellent, but the figures in the text have suffered from the quality of the paper on which they have been reproduced. The book, although on a highly specialised subject, has the merit of being exceedingly readable; the treatment and the style are a model for a scientific monograph.

Books Received

(Mention in this column does not preclude a review.)

The Temple Coins of Olympia. By CHARLES T. SELTMAN. With a Foreword by SIR WILLIAM RIDGEWAY. Illustrated. (Cambridge: Bowes and Bowes.)

A Short History of the International Language Movement. By PROFESSOR A. L. GUÉRARD. (T. Fisher Unwin, Ltd., 21*s*.)

Man, the Animal. By PROFESSOR W. M. SMALLWOOD, Ph.D. Illustrated. (The Macmillan Co., 12*s*.)

Plane Geometry. By L. B. BENNY, M.A., F.R.A.S. (Blackie & Son, Ltd., 10*s*. 6*d*.)

Atmospheric Pollution. Report by the Advisory Committeee on observations in the year ending March 31, 1921. (Published for the Meteorological Office, Air Ministry, by H.M. Stationery Office, 2*s*.)

Le Leggi delle Soluzione diluite ed Elettrolitiche secondo il metodo sperimentale. By ING. PROFESSORE GAETANO IVALDI. (Milano: Stab. Tip. Lit. Stuechi, Ceretti E.C.)

Earth Evolution and its Facial Expression. By WILLIAM HERBERT HOBBS. (Macmillan & Co., Ltd., 15*s*.)
See review in this issue.

Mathematics for Students of Agriculture. By SAMUEL EUGENE RASOR. (Macmillan & Co., Ltd., 7*s*. 6*d*.)

A year's course of work in mathematics for students taking agricultural courses in vocational and technical schools and colleges, by the professor of mathematics in the Ohio State University.

Notes and Examples on the Theory of Heat and Heat Engines. BY JOHN CASE, M.A. (Heffer, 7*s*. 6*d*.)

A very useful *cram* book with many good examples worked and unworked.

A Concise History of Chemistry. By T. P. HILDITCH, D.Sc., F.I.C. Second Edition. (Methuen & Co., Ltd., 6*s*.)

Students of chemistry will find this a useful book. It is excellent in plan, trustworthy, astonishingly comprehensive, easily consulted, and it is readable. The call for a new edition has enabled the author to bring the record up to date. Of course everything is not said, but how could it be in 225 pages? It is all "business"; no human touches, not a single little personal anecdote, no pictures. A few slips have been carried over from the first edition. Radium, for example, is described as having been isolated in 1902 instead of in 1898.

Organic Chemistry, or Chemistry of the Carbon Compounds. By VICTOR VON RICHTER. Vol. II. *Chemistry of the Carbocyclic Compounds.* Translated from the Eleventh German Edition by E. E. FOURNIER D'ALBE, D.Sc. (Kegan Paul, 35*s*.)

A reference book that has stood the test of time, crowded with facts which are admirably arranged and well indexed. In its English dress it has two obvious defects: it is translated from a book ten years old, and the translation is

poor. Many technical terms are not given their English equivalents, but names which are literal translations of the German; and some of the English is not English.

Inorganic Chemistry. By T. Martin Lowry, C.B.E., D.Sc., F.R.S. (Macmillan & Co., Ltd., 28s.)

Correspondence

JUPITER'S SATELLITES

To the Editor of Discovery

Sir,

I have read with much interest the article by the Rev. Hector Macpherson on "The Giant Planets," in the March issue of Discovery.

Considering the suggestion made in the article referred to that the smaller satellites of Jupiter may be "captured" asteroids, in contradistinction from the origination of the larger satellites, which may be considered to have been formed out of the original Jovian mass, in like manner as the earth-moon satellite was doubtless formed, would not the "captured" asteroids have greatly elongated orbits, compared with the orbits of the larger satellites of Jupiter?

Yours, etc.,
Legh Osborn.

23 Queen Street, Darlington.
March 2, 1922.

To the Editor of Discovery

Sir,

In reply to Mr. Osborn's letter, the suggestion has been made from time to time that the smaller Jovian satellites and the satellites of Mars were originally asteroids which at some epoch in the remote past came into the spheres of influence of these planets. But, of course, the suggestion is merely a suggestion. At the same time, the similarity in size between these tiny moons and the asteroids seems to call for some such explanation.

As to the question raised by Mr. Osborn regarding the shape of the orbits of these satellites, Professor T. J. J. See's "capture theory" may be helpful. He believes that all satellites "formerly moved about the sun, and since they were captured have had their orbits reduced in size and rounded up under the secular action of the resisting medium formerly pervading our Solar System." Few astronomers would be disposed to accept this theory in its entirety. But it is not improbable that it is a satisfactory explanation of the present orbits of these minute moons.

Yours, etc.,
Hector Macpherson.

30 Pilrig Street, Edinburgh.
March 7, 1922.

RACIAL INTERMARRIAGE

To the Editor of Discovery

Sir,

When in a public library to-day, I glanced through your March correspondence column and noticed a query about the above.

If it be of any interest to your inquirer, I may say that in 1902 I was assisting another medical practitioner in a coast town of a south-east county in England, and came across a family of seven children which was the result of one of these marriages. The African parent was of a South African race, the mother was English; and the children took completely in appearance after one or other of the parents. There was *no* child in this family which showed part European and part African. From what I saw of them, the children were healthy so far as general health was concerned; but I understood that they were inclined to take sides in the event of a dispute between two of different appearances over some trifling matter which, unless the parents were present at the time, was liable to develop rapidly into a more serious family squabble.

Yours, etc.,
Frederick D. Welch,
M.R.C.S., L.R.C.P.

Hartley, Longfield, Kent.
March 24, 1922.

THE PROBLEM OF PERSONALITY

To the Editor of Discovery

Sir,

The suggestion in your Editorial Notes for April, that a Commission should be set up to collate views from all angles on the Problem of Human Personality, is a most valuable one. In the first place, it is a crying need of the times that the public should, if it be possible, be given some orientation in matters where they are at present the prey of writers and speakers, either those who combine glibness with ignorance, whose efforts appear daily in the Press, or those who suffer from a fixed idea, of whom the gentleman whose work, *The Glands Regulating Personality*, has apparently led you to make the aforesaid suggestion, would appear to be a good, if extreme, example.

Secondly, if a Commission of this sort could be established, the door would be opened for work on a far wider field—the Co-ordination of Science in general.

It is unnecessary to enlarge on what is more than a tendency of modern Science and Thought to work in watertight compartments. In matters of deep research and high achievement the process is inevitable. One may, however, venture the prophecy that Science and Philosophy will sooner or later be forced to make a great effort to obtain co-ordination of all their branches, and that, when this is achieved, not only will there be direct results of the utmost importance resulting from the linking up of different lines of research and thought, but the world will find itself possessed of an intellectual mechanism that may conceivably open the way to fields of which at present one can only dream.

Yours, etc.,
Frank W. Herbert.

18 Upper Phillimore Place,
Kensington, W.8.
April 7, 1922.

DISCOVERY

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Editorial Notes

We feel sure that a consideration of certain aspects of the Genoa Conference will not be out of place here. The particular political and economic questions which have been deliberated at Genoa—the treaty of Rapallo, for instance, or the problem of Russia's payment of her debts to ourselves and France—are not the concern of these notes. What does concern us is the historical significance of the Conference. Whatever its eventual results, the Conference will have been symptomatic of a steadily growing international consciousness. On more than one occasion we have commented on this striking tendency of the new era upon which we believe we are entering. What lies at the back of these conferences, of these attempts by the great nations to harmonise their conflicting interests? An idealism, surely, matured by two vital realisations—that the nations of the world, and in particular the United States of Europe, to use a term coined by Mr. H. G. Wells, are so closely bound together by financial and economic ties, that open co-operation between them is essential; and that another great war using ten times the destructive material of the last may deal a death-blow to our already sorely wounded and slowly recovering civilisation.

To state these two realisations to-day is almost to state two platitudes. Especially is this true of the second realisation, which, however, as a scientific journal we desire to consider from a particular angle. This is the question of the part likely to be played by scientists in the next war on a grand scale. In certain quarters there is a semi-conscious hostility towards "scientists" in general for the horrors which they contributed to the recent war. Yet, setting aside the first employment of gas by the Germans, how far can they be considered as responsible for these horrors? As the war continued the younger active men of every nation found themselves defending their own country according to the best of their mental and physical abilities and thus necessarily acting as cogs in the general machinery of destruction and violence. It is very questionable whether you can blame the man who invented a new deadly gas more than the man who despatched it to the enemy's lines in a shell. In the mental turmoil of war both believed that they were acting for the best, in the interests of their country, or in those of civilisation.

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We are conscious that the ethical point here raised is exceedingly deep and difficult of decision. What is certain, however, is that circumstances originally caused by men are eventually stronger than men themselves. A writer stated [1] some months back: "It would be a very inspiring sight if the scientists of all civilised peoples were to become 'class-conscious' to the extent of laying a ban of excommunication from their academic and professional unions on any one of their number who, in peace or war, should aid a government to prepare or carry out its acts of mass murder. We can just conceive the passing of some such resolution at an international scientific congress, but we should doubt the probability of its observance when the strain of nationalist passion was felt, and we should expect, at the least, that the 'blacklegs'

[1] See article on *The Conscience of Science* in The Nation and the Athenæum for September 17, 1921.

would be numerous." This is to our mind a fair statement of the case, and, even were scientists to stand out of the next war as a solid body of conscientious objectors, the munitions already producible by the factories are terrible enough.

* * * * *

Such a revolution by scientists could never act, even at its best, as more than a narcotic. To kill the disease of war we have to cut at its roots. We believe that that is how most scientists view the matter, and why they—the predestined and unwilling instruments of torture—cannot but welcome any move to sift and reconcile national passions, and to prevent further wars. This attitude was apparent at the meeting of the British Association last September. The vistas of future knowledge and prosperity which scientific research is rapidly opening up are more visible to the eyes of the researchers than to anyone else ; and the value of a long peace to attain those vistas is, we are certain, most intensely felt by a class of men who are as humane as they are human.

* * * * *

An important point which crops up in connection with these international conferences, and which is sure to gain the increasing attention of statesmen and civil servants as international relations become more definite, is the matter of a common language for their facilitation. Undoubtedly much friction was caused at Versailles in 1919 with regard to this problem, which was, as a matter of fact, eventually solved by holding the meetings of the " Big Three " in English, the meetings of the " Big Five " in French and English, and the public meetings chiefly in French. Again, the babel of Genoa has required the most brilliant linguistic talents to reduce it to any kind of order, and a great deal of time has been inevitably wasted in interpretation. Professor Guérard, a very able French scholar, has lately written a most stimulating book on the subject of international languages.[1] He advocates the gradually expanding employment of a common language which would not " supersede the existing national tongues any more than the League of Nations is meant to absorb the existing national States," but which would act as a " mere auxiliary."

* * * * *

Is there any language suitable for this purpose ? In an endeavour to answer this question Professor Guérard has divided his book into three parts, covering in the first the natural languages at our disposal, in the second the artificial, and in the third some summaries of the two foregoing parts and the anticipations to which they give rise. From the languages of Western civilisation Professor Guérard selects two as predominant and most ideal for expansion—French, largely on account of its past and present use as a diplomatic and commercial language and for its elastic qualities of expressing thought, and English largely on account of the power and wide diffusion of Anglo-Saxon races in the world. He points out that a condominium of these two languages might serve the purpose of a *lingua franca*. " This means nothing more than organising a spontaneous development, accelerating an evolution already well under way. If, by some diplomatic agreement, the teaching of French were made universal in the British Empire and in the United States, whilst all students in France were required to learn English, an immense progress would be realised. Two hundred million men would have a direct means of communication ; the rest of the world, instead of remaining perplexed before the multiplicity of languages, would have only two to master." But the professor is far-sighted enough to realise that " in a democracy of nations, the claims of the 'great powers' will never be whole-heartedly conceded and the distinction between major and minor languages likewise will ever remain offensive."

* * * * *

Again, the claims of Latin, taught throughout the schools of Europe, come before us, but are rendered of little account for the reason that the language is dead and favours invidiously those nations which speak Romance tongues. Professor Guérard turns to the artificial languages for a solution. Out of the hundred or so projected, half-completed, and completed systems, he selects Esperanto for its practical success, but states that " the final solution seems to us to lie between the dialect of Zamenhof, too hybrid and arbitrary, and that of Peano, too irregular in its 'naturalness'; more precisely between Ido and Romanal." It is in such a " Cosmoglotta," as he terms the international language which might result from this combination, that Professor Guérard looks for the salvation and progress of mankind. We find it difficult to share the author's optimism, yet we recommend his book for its extremely suggestive and stimulating qualities.

* * * * *

A considerable amount of correspondence has reached us as the result of the Editorial Notes in our March number suggesting the establishment of a commission to inquire into the problem of personality. It is apparent that, apart from its other functions, Discovery is becoming a channel of expression for the thoughts and ideas of a large intellectual portion of the British public, and of its attitude to, and interest in, scientific research. That attitude, we consider, should be given a wide hearing, and Discovery intends to give it—in its editorial notes and correspondence columns.

[1] *A Short History of the International Language Movement*, by A. L. Guérard. (T. Fisher Unwin, Ltd., 21*s*.)

Some New Discoveries in Prehistoric Art

By George Frederic Lees

It was recently announced in the daily press that two French *savants*, Dr. Cuguillière and M. Bacquié, had made some striking discoveries bearing on prehistoric art in the caves of the Valley of Ussat, in Southern France. Specimens of rough pottery and drawings, tombs with funeral urns and designs cut in the rock, and certain curious red signs engraved upon the white and ochre walls were reported to have been brought to light. "Remarkable relics of the Stone Age, including primitive sketches of animals—horses and mountain goats drawn with skill," the newspaper account proceeded to announce in a manner apt to mislead those who take a serious interest in palæontological research.

The above announcement, which was necessarily unaccompanied by documentary evidence in the form of photographs or sketches, is a case in point. Quite unintentionally, the importance of the new discovery in the country of the "Roches de Feu" has been exaggerated. The Abbé H. Breuil, of the Institut de Paléontologie Humaine, Paris, the leading French authority on Prehistoric art, and one of the contributors to that fine series of illustrated volumes published under the general title of *Peintures et gravures murale : des Cavernes paléolithiques*, visited Ussat in September of last year ; but in his opinion the discoveries, though certainly interesting, are very modest ones. His report—" un petit travail "—will not be ready until next summer, he writes to me, and he very much doubts whether the contents merit being brought to the knowledge of the general public.

There are, however, recent discoveries in the realm of prehistoric art which are well worth bringing to the notice of English palæontologists. I refer to those made by Dr. Lucien Mayet, of the anthropological section of the University of Lyons, and M. Jean Pissot in the Colombière caves near Poncin, in the Department of Ain. These diggers came across there a complete workshop of an Aurignacian engraver, including numerous specimens on limestone blocks and bones, lying side by side with numerous flint tools with which the artist of the Reindeer Age did his engravings. In close proximity were flat-surfaced blocks, probably used as seats ; and the hypothesis is that the workers were obliged to abandon their *atelier* through a sudden rising of the waters of the adjoining river Ain, since tools and artistic productions were found to be covered with fine sand from the river-bed.

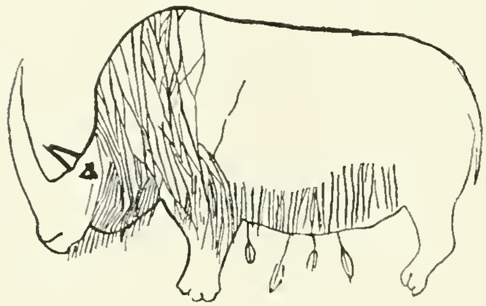
Some of the most interesting of the prehistoric drawings brought to light included two human figures engraved on a mammoth bone, a man stretched on his back with one arm raised vertically, and above, turned to the right, the unfinished silhouette of a woman. Whereas the figure of the man, with his big head, long thick nose, and hairy chin and body, gives the impression of brutality, that of the woman is expressive of grace—in brief, the figure of a veritable Venus of the Stone Age compared with the extraordinarily developed women represented by the well-known Aurignacian sculptures of Brassempouy, Villendorf and Laussel. Two other drawings were on the same piece of bone ; one of a bear, the other of a stag's antlers. It is claimed by the authors of this discovery that we have here an instance of the earliest known engraving of the human figure on mammoth bone—a contention which has given rise to a certain amount of discussion, in which it seems to me MM. Mayet and Pissot have the best of the argument.

The engravings on limestone represent a whole series

Fig. 1.—The Colombière cave near Poncin (Ain), one of the typical prehistoric caves of France.

of animals. On one stone are a chamois, a stag's head, a felid and other animals of doubtful nature ; on another is a fine representation of the head of a galloping horse, with its mane streaming in the wind—certainly the best

of the engravings of the Colombière caves ; on a third stone is the complete engraving of a rhinoceros with a series of arrows hanging from its belly. Prehistoric figures of animals similarly pierced with arrows have been found in other caves in France, notably at Chaffaud (Vienne), at Eyzies (Dordogne), and at Mieux (Ardèche). Finally, there was another incomplete but finely executed engraving of an animal which, after the Abbé Breuil had given his opinion upon it, was identified as a musk-ox, which has rarely been depicted by artists of the Reindeer Age.



Rhinoceros, with arrows.

Stag, with two arrows.

Stag.

Figure of horse with flowing mane, engraved on limestone.

FIG. 2.—TRACINGS OF ENGRAVINGS FOUND IN THE COLOMBIÈRE CAVES, AIN, FRANCE.

Contemplation of these and similar drawings or sculpture has given rise to much speculation regarding their use and meaning. Dr. Mayet apparently inclines to the belief that these animal pictures may have been used as talismans, capable of assuring the fortunate possessor of a fruitful day's hunting. Many prehistorians — and that eminent authority M. Salomon Reinach among them—believe that these cave pictures were connected with magical practices. But with this theory M. Marcellin Boule, the Director of the Institute of Human Palæontology, of Paris, cannot quite agree. In his opinion we have here the earliest instances of art for art's sake, though he does not deny that they may have had a slight connection with magic.

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Taxation and Unemployment

By Douglas Knoop, M.A.

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THE purpose of this article is to examine the connection between taxation and unemployment. Though students of the problem of unemployment have paid little or no attention until recently to the possible influences of taxation, students of public finance have always contemplated the possible discouragement to industry and trade which might be brought about by unwise or excessive taxation. This point was emphasised by Adam Smith as early as 1776.[1] In stating his fourth maxim of taxation, he noted that a tax "may obstruct the industry of the people, and discourage them from applying to certain branches of business which might give maintenance and employment to great multitudes." Subsequent writers on public finance have all laid stress on this so-called canon of economy, with a distinct tendency to emphasise its importance even more than was done by Adam Smith.

That it is theoretically possible to crush an industry almost, or entirely, out of existence by means of high taxation must be admitted; an actual case is noted in the Poor Law Report of 1834, viz. farming in the parish of Cholesbury in Bucks. Whilst the population was almost stationary from 1801 to 1831, the rates had increased from £10 14*s*. at the end of the eighteenth century to £99 4*s*. in 1816, and to £150 5*s*. in 1831. In 1832 the attempt was made to collect rates amounting to £367, but it proved an impossibility as the landlords gave up their rents, the farmers their tenancies, and the clergyman his glebe and his tithes. Thus the whole parish was abandoned owing to excessive rates and the labourers were thrown out of employment.

The connection between taxation and unemployment in this country at the present time does not appear to be exactly of this character. Roughly, it seems possible to distinguish two types of cases: in the first, the prevailing depression in trade is having an unfavourable influence on taxation; in the second, taxation is having an unfavourable influence on the depression in trade, but probably rather by checking a recovery than by actually causing unemployment. I propose to examine these two types of cases in turn.

I

1. A tax is not always paid finally by the person or firm from whom it is collected; the payer in the first instance may succeed in shifting it on to someone with whom he has economic relations, e.g. a tobacco manufacturer probably shifts the tobacco duty on to the tobacconist, who in his turn passes it on to the smokers in the form of an enhanced price. The problem as to who finally pays a particular tax is often very complex, and I must content myself here with drawing attention to one consideration. When the demand for the products of industry is slack, it is always much more difficult to shift the final payment of taxes on to buyers than when the demand is keen. Consequently, at the present time, owing to the great falling off in the demand for many products, it is probable that business firms have to pay finally a bigger share of rates and taxes than was the case a year or two ago.

2. Both individuals and business firms, in so far as they finally pay taxes, regard taxation as involving a sacrifice or burden, because it compulsorily deprives them of part of their resources in return for somewhat remote and indefinite services, the value of which does not appear to them to be worth the sum paid in taxation. The extent of the burden or sacrifice would appear to depend largely upon the use which the taxpayers could have made of the sums paid in taxation, had these remained in their possession. At this point it is necessary to distinguish between the cases of private individuals and of business undertakings. The larger the income of an individual, the less urgent do the wants tend to become which he is prevented from satisfying because of taxation. Consequently £3,000 taken in taxation from a person with £10,000 a year probably causes less sacrifice than £300 taken in taxation from a person with £1,000 a year. In so far as taxes do finally rest upon business firms, e.g. income tax on sums placed to reserve, the mere size of the resources affected by the taxation appears to be no indication of the urgency of the wants which could have been satisfied, had the sums taken in taxation been available for use at the discretion of the firms concerned. One firm paying £30,000 income tax in respect of £70,000 placed to reserve may be in a far better position to use the money, and in far more urgent need of it, than another firm paying £3,000 income tax in respect of £7,000 placed to reserve.

At the present time practically all firms are in need of liquid resources for business purposes, and the drain of ready money involved by taxation payments is particularly burdensome. At times when resources are more liquid, or when credit is more easily obtained, the burden of taxation is not so severely felt.

3. Owing to the fall in the general level of prices associated with the depression in trade, and the consequent increase in the purchasing power of money, rates of taxation have automatically become heavier in certain cases. Thus specific customs or excise duties, like those on spirits, beer, tobacco, tea, and sugar, represent more to would-be buyers to-day than

[1] *Wealth of Nations*, Book V, chap. ii, part 2.

they did a year or two ago. Looking at the problem in another way, the large fixed duties which enter into the selling prices of certain articles prevent the prices of these articles from falling in approximately the same proportion as the prices of non-taxed articles are falling, and thus discourage sales to the detriment of the manufacturers and dealers concerned.

4. The sudden depression following on a period of steadily improving trade has led, in many cases, to increased assessments for income tax at a time when profits are seriously reduced. The full effect of the various rises in income tax during the war had probably not been felt by business firms prior to the recent slump, as the assessments were based on the average profits of the previous three years, which, owing to improving trade, tended to be lower than the actual profits of the year in which the tax had to be paid. We may suppose that X. & Co. had profits of £10,000 in 1917, £12,000 in 1918, £20,000 in 1919, and £30,000 in 1920. In January 1921 they would be called upon to pay income tax on $\frac{£10,000 + 12,000 + 20,000}{3} = £14,000$ at 6*s.* in the pound, i.e. £4,200. This sum would probably be paid out of the profits of 1920, and represents only 2*s.* $9\frac{3}{5}$*d.* in the pound on £30,000 profits. The following year the position would be quite different, owing to the sudden slump. In 1921 we will suppose that X. & Co. made a profit of £5,000. At the beginning of 1922 they would be called upon to pay income tax on $\frac{£12,000+20,000+30,000}{3}=£20,667$ at 6*s.* in the pound, i.e. £6,200. This sum exceeds the actual profits of 1921, representing a tax of £1 4*s.* 9*d.* in the pound. At first sight this appears to be an appalling hardship; it is known, however, to all business men that under the three-year average system income tax payments work out lightly in years of improving trade, and heavily in the years of declining trade, especially in the first year after trade has begun to decline, so that it is very desirable in good years to place sums to reserve to meet income tax payments in bad years. Even if this precaution has been taken, the making of the income tax payment will be a cause of difficulty, unless the income tax reserve is in a liquid form. It must also be remembered that under the three-year average system the total amount paid in income tax over a long period of years works out to very much the same sum as if the tax on each occasion were based on the profit of a single year, only the fluctuations in the amount due each year are less violent under the averaging system.

Where firms are privately owned, the partners are subject to super-tax as well as to income tax. The amount of a taxpayer's income for super-tax purposes is, roughly speaking, the amount of income on which he has borne income tax the previous year. Thus super-tax figures lag even further behind current profits than do income tax figures. If X. & Co., of the previous paragraph, belonged to one man he would in January 1922 be paying income tax on £20,667 (average for 1918, 1919, and 1920) and super-tax on £14,000 (average for 1917, 1918, and 1919). The necessity to accumulate liquid reserves to pay super-tax during a depression in trade is as great as it is in the case of income tax.

II

We must now turn to the other side of the picture and consider the effects which high taxation may have on the depression in trade. I propose to distinguish five cases, three of which may be described as material and two as psychological.

1. High taxation tends to diminish the opportunities to save, thus restricting the flow of new capital which is so essential as a stimulant to trade and industry. So far as the individual is concerned, it is sometimes urged that, the higher the rate of taxation, the greater the effort that will be made to save for future uses, because, the higher the rate of taxation, the larger the gross income that will be necessary in the future in order to yield a preconceived net income after payment of taxation. It is doubtful, however, whether many individuals look at the problem in this way, and, even if they do, whether, after paying their taxes and meeting what they regard as necessary expenditure, they are in a position to save more than formerly. So far as a business firm is concerned, the prejudicial effect on saving, of high taxation which cannot easily be shifted, appears to be unquestionable. "Saving," in the case of a firm, consists in reserving sums out of current profits for use in developing and expanding the undertaking. Sound finance undoubtedly calls for the accumulation and use in the business of such reserves, yet in the case of a privately owned firm income tax and super-tax, and, in the case of a public company, income tax and corporation profits tax, make very heavy inroads into the profits and greatly reduce the sums available for financing developments.

2. High taxation tends to discourage the provision made for wear and tear of plant, machinery, etc. Allowing repairs and renewals to fall into arrear not only reduces the productive capacity of the industry concerned in the future, but prejudices in the present the trades with which the renewal orders would have been placed. It is more especially high income tax which discourages proper provision for depreciation, because the sums which the Inland Revenue allow firms to charge as expenses on account of depreciation, in ascertaining their incomes for income tax purposes, tend to be considerably less than the actual cost of repairs and renewals. Thus, repairs and renewals have

to be financed to a considerable extent out of profits subject to income tax. When £1,000 of profits are required to pay for £700 of repairs, firms are loath to carry out more than the most urgent repairs.

3. It is claimed by many authorities that certain new taxes, especially those levied in connection with the Safeguarding of Industries Act, are impeding foreign trade, not merely by the imposition of a $33\frac{1}{3}$ per cent. tax which formerly did not exist, but by the uncertainties and petty quibbles to which that Act has opened the door.

4. The chief psychological effect of high taxation appears to be to promote pessimism and to discourage enterprise amongst business men. There can be no question that all business transactions involve risks and that the uncertainty now prevailing about price movements makes the risks bigger than usual. If business risks are successfully negotiated, the Government, through taxation, takes a substantial slice of the resulting profits ; whereas, if the risks prove too great and losses are incurred, the Government does not fully share them. The business community, in many cases, appears to feel that the game is not worth the candle under present circumstances and prefers to wait for more favourable conditions before launching out. The prospect of retaining a bigger share of profits, if made, would probably act as an incentive to adopt a more enterprising policy.

5. A second psychological effect of high taxation is that it tends to diminish the incentive to work, and in certain cases, at least, will lead to less work being done. An individual is prepared to do a certain amount of extra work for the sake of earning an extra pound, but if that pound is reduced to 17*s.* or 14*s.* by the deduction of 3*s.* or 6*s.* income tax, the incentive will be less. He may do the extra work, nevertheless, for the sake of maintaining his standard of life, or he may do some of the extra work, preferring his leisure to doing the last and most disagreeable part of it ; or he may do none of the extra work, so as entirely to escape the tax liability which would accrue on his income passing a certain sum. It is certainly commonly believed that miners fairly recently, if not at present, have deliberately refrained from work, when the pay corresponding to that work would raise their incomes above the exemption limit of the income tax. Reduced output, whether brought about by this or any other cause, tends to increase the cost of production and penalise all industries which have to use the restricted output.

III

Whilst it is conceivable that a particular industry or even business generally, might be almost taxed out of existence, it fortunately does not appear as if such an acute position had been reached in this country. The situation here may perhaps be summarised by saying (1) that the prevailing depression has tended to augment certain taxes ; and (2) that high taxation is tending to aggravate the problem of unemployment which has been primarily caused by other circumstances.[1] It is somewhat doubtful as to how far a modest reduction in taxation would help to stimulate employment. Anything more than a modest reduction in taxation is almost inconceivable in view of the position of the national finances ; even a modest reduction might prove very embarrassing, though it has to be remembered that, if it really succeeded in stimulating trade sufficiently, the reduced taxes might yield as much with improved trade, as the higher taxes would with more depressed trade. If taxation were reduced and the revenue suffered, we must briefly consider how the Government could hope to make both ends meet.

1. The sums provided in the Budget for the repayment of debt might be curtailed, or even eliminated, for the time being. Unfortunately, since the Armistice, there has been no reduction of debt out of taxation revenue ; such debt reduction as has been achieved has been financed out of the sums obtained from the sale of surplus stores, etc., and some of these sums, which are really capital and not income, have had to be employed to meet current expenditure. As nothing has been raised by taxation for the repayment of debt, there is no relief to be found in that direction.

2. Some services, which are at present paid for out of taxation, might be defrayed instead out of borrowed money. Financially, this would be one step worse than meeting current liabilities out of the proceeds of the sale of surplus stores, etc. When we remember that our international credit and the movements of the Foreign Exchange depend very largely upon the soundness of our national finances, it is difficult to approve of this extreme step as a deliberate policy.

3. Sufficient economies might be effected in national expenditure to enable taxation to be reduced. The difficulty here is that a very big reduction in expenditure is required to make both ends meet in 1922–3, without any question of managing with less taxation revenue, so that this solution does not appear to offer very much prospect of relief.

The authorities are faced by a choice of evils : to reduce taxation and jeopardise the national finances ; to maintain taxation and jeopardise trade recovery. The one comforting thought in the dilemma is that this is a case where it is not necessary to plump solidly in favour of one course or the other ; a solution may possibly be found in some kind of compromise.

April 29, 1922.

[1] See my article on *The Problem of Unemployment* in DISCOVERY for November 1921.

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Some Recent Work on the Ductless Glands

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It is a matter of common knowledge that the nervous system directs into appropriate channels of response the stimuli which an animal receives from its surroundings. But the nervous system does not constitute the sole mechanism known to be instrumental in co-ordinating the behaviour of the organism. During the past twenty-five years it has been increasingly recognised that, as Brown Séquard was among the first to foresee, the blood stream provides an alternative channel by which chemical compounds produced in one part of the body may evoke a reaction in another organ remotely situated with respect to it. As an illustration a discovery made at the beginning of this century by Bayliss and Starling will serve. When food is presented to an animal like the dog, it secretes saliva; nervous impulses pass from the organs of vision, taste, or smell to the brain, and are directed thence into the motor nerves which stimulate the salivary glands to activity. Similarly, when food enters the small intestine, the digestive gland known as the pancreas begins to secrete actively. But the way in which this organ is activated is entirely different. The acid food coming from the stomach acts upon a substance present in the intestinal wall to set free a compound called by Bayliss and Starling "secretin." This *secretin* diffuses into the blood stream, and is carried sooner or later to the pancreas, on which it has a specifically excitatory action.

Such chemical messengers are spoken of as *hormones*. And there exist in the body a number of organs whose unique function is to regulate various activities by setting free into the blood stream hormones or internal secretions which act specifically either in producing such immediately visible responses as muscular movement or secretion in other organs or the more subtle form of regulation involved in the growth processes. Such structures are known as ductless or *endocrine* glands. Two of the most important of the ductless glands are the *thyroid*, situated on the ventral side of the throat, and the *pituitary*, encased in a depression of the skull at the base of the brain. Both glands are of the utmost medical importance; but they are also significant to an understanding of some of the most baffling problems of animal physiology; and it is the purpose of this article to outline some recent discoveries relating to the function of the thyroid and pituitary glands which open up wide fields for inquiry though not of themselves directly utilitarian.

The interest of biologists became focused on the question of internal secretion in its non-medical bearings, especially through a discovery made ten years ago by Gudernatsch. This worker experimented with dieting tadpoles of the common frog on various kinds of tissue such as brain, liver, etc., including the ductless glands such as the thyroid. He employed an enormous variety of tissue foods, and he found that, with the exception of those individuals which were brought up on a thyroid diet, the tadpoles grew at much the same rate and transformed into frogs at about the same time as they do in natural surroundings. The tadpoles reared on a thyroid diet were, however, quite exceptional in transforming into frogs at a much earlier date and long before attaining the dimensions with which metamorphosis is ordinarily associated. How potent is the thyroid tissue in effecting the change may be judged from the result of later experiments by Swingle (1918) on the large American frog *Rana catesbiana*, which, unlike our own species, takes three seasons in the ordinary course of events to reach the adult condition. Fed on fresh thyroid gland *Rana catesbiana* will complete its larval life and transform into a pygmy frog at the age of six weeks.

Gudernatsch's discovery was soon confirmed by the observations of several other workers—Morse, Barthelemez, and Swingle—who obtained corresponding results with other larvæ of amphibians (toads, newts, salamanders, etc.). It does not in itself establish a relation between the thyroid gland's activity and the transformation of the tadpole into the frog; for the thyroids used in the experiments were taken from sheep and oxen—animals widely separated from the frog and its allies. However, the facts which had been elicited stimulated other workers to explore the ground more thoroughly. Bennet Allen, an American zoologist, succeeded (1916–18) in overcoming the technical difficulties of removing the thyroid from tadpoles of the toad. The delicate operation of extirpating the rudiment of the thyroid from very young larvæ was carried out with a cataract needle under a microscope. The wound produced heals within an hour, and fortunately the amphibia are free from susceptibility to septic poisoning. Tadpoles deprived of their thyroids at this early stage grow in a perfectly normal manner, until they reach the age at which metamorphosis would be expected to occur. Instead of undergoing transformation at this juncture into the adult form, they retain their gills and tails, the forelimb rudiments fail to break through the skin, and the animals continue to grow, attaining dimensions far exceeding those of the ordinary tadpole. In short, they lack the power to undergo metamorphosis under normal conditions. Thyroidless tadpoles do nevertheless complete their development and emerge from the larval phase, if, as Swingle was able to show later (1918), they

are fed with thyroid tissue. This discovery of Allen's was soon afterwards confirmed by the work of E. R. and M. M. Hoskins. And we may say at this point that the behaviour of the thyroidless tadpoles completes the evidence for regarding the activity of the thyroid gland as an essential factor in controlling the metamorphosis of the frog and its allies.

This fact is of considerable interest to those who are concerned primarily with the physiology of development and growth. But the metamorphosis of the tadpole has an ulterior significance which is related to important questions in human physiology. That the thyroid is a ductless gland was first established by the discovery that the condition of arrested physical and mental growth (cretinism) in children associated with thyroid deficiency is remediable by injection, implantation, or feeding with thyroid gland substance. For many years it has been known that the thyroid contains a higher percentage of the element *iodine* than any other portion of the body; and iodine compounds have been administered medicinally in thyroid disorders. The precise significance of the connection between iodine and the thyroid has been the subject of much controversy. Some have regarded the presence of iodine in the thyroid as unimportant; others have held that the thyroid hormone (or *autacoid*) is an iodine compound. It is, of course, impossible to traverse the intricacies of this discussion in this article. It is sufficient to say that the study of the transformation of the tadpole into the frog has heavily weighted the scales in favour of the latter view.

Soon after Gudernatsch's observations appeared Morse succeeded in obtaining similar results with the use of *iodised* blood albumen; and Lenhart (1916) was able to show that the rate of metamorphosis in tadpoles fed on thyroid diet depends on the iodine content of the glands used. These observations led to a brilliant series of inquiries by Swingle (1918–20), who proved that iodine (free of organic combination) administered either with the food or dissolved in the water will not only induce, like thyroid substance, a precocious metamorphosis in normal larvæ, but will also enable thyroidless tadpoles to complete their development. Frog tadpoles can be made to complete their metamorphosis even when deprived of their thyroids, if a sufficient quantity of iodine is supplied to them. The same is true of salamander larvæ (Uhlenhuth). Thus in these creatures the thyroid acts as a storage organ for iodine, accumulating the latter as the immature larva grows from the minute traces of iodine in their normal food, and eventually liberating it in the form of a highly active substance which, circulating in the blood stream, leads to the destruction of the larval characters (gills and tail) and to the growth of the forelimbs and other adult features.

It has been mentioned that the relation of the thyroid to metamorphosis has been established in newts and salamanders as well as in frogs and toads. These tailed amphibians also start their free life with a bodily organisation very different from that of the adult form; but the details are not quite the same. In newts and salamanders the metamorphosis is less abrupt; they are hatched from the egg with limbs fully developed; and they do not—like the tadpole possess a gill-cover of *operculum*. In its place there arises on either side of the head, as in the very young frog tadpole, a tuft of filaments, the external gills. Metamorphosis essentially consists in the loss of these gills and the fin which runs along the back and either

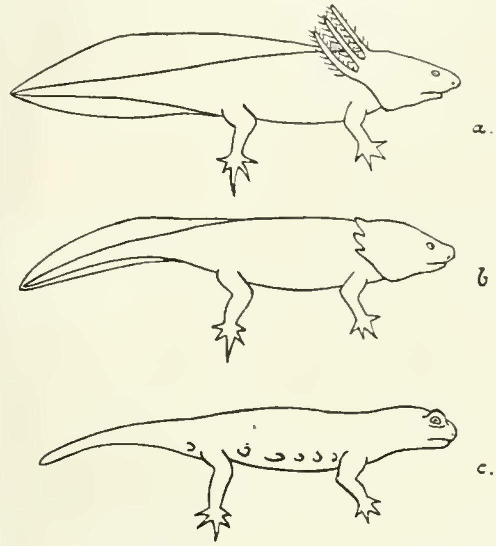

FIG. 1. A. Axolotl larva.
B. Intermediate stage after a fortnight's thyroid feeding.
C. The fully developed Mexican Salamander.

side of the tail, which latter passes over into the adult and is not destroyed as in frogs and toads. Sometimes these amphibian larvæ fail in nature to transform at the ordinary time and assume sexual maturity while still in the larval state. This has become a permanent condition in the case of the Mexican salamander of certain localities. The "axolotl," or larva of the Mexican salamander, never leaves the water, but reproduces from generation to generation in the gilled condition.

Naturally, when young specimens were imported from Mexico, reared to maturity, and bred in the Jardin des Plantes for the first time, in 1863, they were regarded as representatives of a small tribe of salamanders which retain the gills, etc., permanently throughout life like the blind cave newt Proteus of Dalmatia and the "hell bender" (*Necturus*) of North American rivers. It was found a year later that offspring of the same stock would, if the water dried up, shed their gills and tail fin, develop eyelids and yellow spots on the belly, and generally assume the appearance of a well-known American salamander of terrestrial habit. The transformation can be brought about by less drastic means and with infallible regularity

in a comparatively short time (three to four weeks) when axolotls are fed on raw thyroid gland from the ox. This was first shown independently by Laufberger (1913) and Jensen (1917), whose work was later confirmed and extended by Huxley and Hogben (1920).

Now there is an interesting circumstance relating to the thyroid-induced metamorphosis of the axolotl which has emerged from the work of the last-named. Iodine has no effect whatever on this species. This appears to indicate that the thyroid of the axolotl is not in working order, though as a matter of fact it is structurally well developed. Does the thyroid gland of the amphibia store iodine and secrete thyroid hormone continuously, or does the activity of the thyroid depend intimately upon internal stimuli ? This question leads us on to a consideration of the other important ductless gland mentioned earlier in this article, namely the *pituitary*.

In the tadpole the pituitary gland which arises as a vesicle of tissue budded off from the roof of the mouth is not fully differentiated at the time of hatching, and it is possible to remove it by the neat insertion of a fine needle without fatal consequences. The technique of this operation was perfected by Bennet Allen (1917) at the same time as his experiments on thyroid removal were in progress, and the results obtained by him have been confirmed by two other workers, Smith and Atwell, who have conducted inquiries on similar lines. Large numbers of pituitaryless tadpoles have now been reared, and the most significant feature they display for present purposes is that they show a retardation in the development of the thyroid, and—like thyroidless tadpoles—a failure to metamorphose. Later Allen (1920) and Swingle (1921) have published preliminary indications of the possibility of inducing metamorphosis precociously by ingrafting the pituitary gland of other individuals into normal tadpoles.

Here the pituitary gland, or, to be more precise, its anterior portion, seems to exercise an influence on development as well as the thyroid ; and recently the writer (Hogben) has induced Axolotls to transform by injections of pituitary extracts. Its precise function in man and the higher animals is not understood, though clinical evidence points to a connection with growth. Of its posterior half much more is known. This portion of the pituitary secretes a hormone (or more probably a group of hormones) which assist in regulating blood pressure, child labour, and the flow of the milk by excitatory action on involuntary muscle and glands. One of these hormones plays an important rôle in regulating the colour of the tadpole.

Most readers will be familiar with the power of certain animals, such as fishes, amphibia, reptiles, and some molluscs, to respond to stimuli—in some cases to the colour of their surroundings—by appropriate changes of colouring of the skin. The chameleon, whose aptitude in quick-change artistry is perhaps a little exaggerated, is the proverbial example ; but more familiar animals like the trout and frog are capable of considerable pigmental changes in quite a short time. A frog that has been kept in the shade and exhibits a coal-black tint will within an hour of removal to white flagstones in the sun develop a pale yellow or flesh-coloured hue. Colour changes of this nature are brought about by the contraction and expansion of certain corpuscles charged with pigment granules and situated near the surface in the skin.

The responses of these microscopic pigment cells are in certain cases adaptive, being co-ordinated in such a way as to render the animal inconspicuous among its surroundings. This is well seen in the case of albino axolotls which have very little pigment, and, if kept in a tank with white glazed sides illuminated from above, remain perfectly white. When transferred to a container with blackened sides similarly illuminated from above, they become in a very few minutes quite dark. This change will not, however, take place in animals whose eyes have been removed, blinded, or covered with an opaque substance. The response—" colour adaptation "—depends upon the appropriation of stimuli by the retina. Nervous impulses probably pass from the brain direct to the pigment cells. But in all probability an important factor in regulating colour change is brought about more in directly by increased secretion of certain of the ductless glands.

Of these the posterior portion of the pituitary gland is of the utmost significance. The frog tadpole is usually dark, in fact black, in colour. Allen and other workers agree in stating that after pituitary removal their tadpoles assumed a pale silvery appearance. This extreme pallor was found, on microscopic observation, to be due to the contraction of the pigment cells. The nature of the symptoms of pituitary removal points to the conclusion that the secretion of this gland maintains the pigment cells in an expanded condition under normal circumstances. This has been directly verified quite recently by Hogben and Winton (1922), who have found that an adult frog can be changed from a pale yellow to a coal-black tint within twenty minutes by injection of an extract equivalent to less than a hundred thousandth of a gram of the substance of the posterior portion of the pituitary.

The secretion of another gland (suprarenal), lying in man above the kidney and acting on involuntary muscle in a manner somewhat similar to the pituitary hormone, when administered to fishes or amphibia alike induces a sharp contraction of the pigment cells, the animal becoming extremely pale. A similar result follows treatment with extracts of another organ—the *pineal body*, at least in the case of tadpoles. The pineal is a small structure lying on the roof of the brain. In some forms—for instance, the archaic New Zealand

lizard, called by the Maoris " Tuatara "—it possesses an eye-like structure, as the researches of Professor Dendy have specially demonstrated, and it is highly probable that our reptilian ancestors possessed an additional eye on the top of the head, surviving to-day merely as a vestige in the pineal. The function of the pineal in modern forms has long excited inquiry. Descartes located the human soul therein, and medical men, whose observations have provided no confirmation for this hypothesis, have advanced reason for regarding it as a ductless gland. The effect of pineal extracts on frog tadpoles seems to imply that it forms a secretion of high physiological activity. McCord and F. Allen (1917), whose results were later confirmed (Huxley and Hogben), have shown that if fresh pineals are given as food to tadpoles, the animals begin to display marked colour changes following each meal after the treatment has been carried on for about a fortnight. Within a quarter of an hour of feeding they assume a ghostly pallor: the internal organs and skeleton are plainly visible through the skin, and they retain this uncanny condition for about two hours. To the observer the spectacle is reminiscent of some of Mr. Wells's descriptions in his story *The Invisible Man*.

In this brief survey we have confined our attention to some discoveries—almost exclusively made during the past five years—in connection with two problems of general interest to the student of animal life, colour adaptation, and development. Within the same period of time several important advances have been made in the medical field, and a vast realm of inquiry has been opened up in relation to internal secretion by the studies of Steinach, Lillie, Goldschmidt, and others, on the part played by the ovaries and testes (reproductive glands) in controlling the sexual characteristics of the organism. These discoveries are so far-reaching that they cannot be discussed apart from the whole body of modern work on sex determination. It may safely be said that the study of ductless glands is at the moment one of the most (perhaps *the* most) fertile fields of investigation; and the progress achieved of late is likely to prove the forerunner of great developments in biological science before many years have elapsed.

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Animal Pets in Ancient Greece

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A FREQUENT topic of our newspapers in the silly season is the questionable morality of the affection lavished by elderly spinsters upon their lap-dogs. There is nothing new under the sun. Plutarch begins his *Life of Pericles* with the following words: " Cæsar once, seeing some wealthy strangers at Rome, carrying up and down with them in their arms and bosoms young puppy dogs and monkeys, embracing and making much of them, took occasion not unnaturally to ask whether the women in their country were not used to bear children; by that prince-like reprimand gravely reflecting upon persons who spend and lavish upon brute beasts that affection and kindness which nature has implanted in us to be bestowed on those of our own kind." [1] As a matter of fact, the love of pets was not confined to strangers in Rome. Catullus wrote a famous poem to Lesbia's pet sparrow,[2] and Ovid celebrated in verse the obsequies of his mistress's parrot.[3] But the moral reflection attributed to Cæsar is a commonplace of considerably older date than the first century B.C. and occurs for the first time, so far as I know, in European literature in the verses of the Athenian comic poet, Eubulus (fourth century B.C.), who complains of the affection lavished upon pet geese, sparrows, and monkeys.[4] Greeks were lovers of pets. Monkeys are first mentioned in Archilochus (end of the eighth century B.C.), and in the fifth century—to judge from the references in the plays of Aristophanes, the comic poet—they were popular though still something of a rarity. In the *Acharnians* (produced 425 B.C.) a Bœotian is persuaded to barter goods for a maker of false accusations—a type of humanity which the poet represents as being common in Athens but rare in Thebes.

> " By this an that an I might make me fortune
> By showing him for a mishievous ape " [5]

is the Bœotian's comment on his bargain. The Man of Petty Ambition whose character is sketched by

[1] Plutarch, *Life of Pericles*, 1.

[2] Catullus, i. 2 (Loeb Classical Library).

[3] Ovid, *Amores*, ii. 6.

[4] Eubulus, Frag. 115 in Kock, *Comicorum Atticorum Fragmenta*.

[5] Aristophanes, *Acharnians*, 905 (trans. Tyrrell). Rogers's admirable translations of Aristophanes' plays are now being issued by G. Bell & Sons in an edition which contains the translation only. A bound copy of each play costs 3*s.* 6*d.*

Theophrastus[1] (372–278 B.C.) went in for pets of all kinds. He kept a monkey and a satyr ape, and "is apt also to buy a little ladder for his domestic jackdaw and to make a little brass shield wherewith the jackdaw shall hop upon the ladder. Or if his little Melitean dog has died, he will put up a little memorial stone with the inscription, 'A Scion of Melita.'"

"I would rather have a good friend," said Socrates, "than the best cock or quail in the world; I would even further say than a horse or dog."[2] The birds and animals referred to were primarily kept for purposes of sport; both cock-fighting and quail-fighting were favourite pastimes with the young bloods of the day. Alcibiades used to carry a favourite quail about with him. Plutarch tells a story of how, when he was distributing largesse among the people, "the multitude thereupon applauding him and shouting, he was so transported at it, that he forgot a quail which he had under his robe, and the bird being frighted with the noise, flew off; upon which the people made louder acclamations than before and many of them started up to pursue the bird; and one Antiochus, a pilot, caught it and restored it to him, for which he was ever after a favourite with Alcibiades."[3]

A pet bird was not an expensive luxury. In the latter half of the fifth century birds could be bought for pets or for the pot from Philocrates, the bird-seller, whose prices were 1 obol for a jackdaw and 3 obols for a crow.[4] The fairest method of assessing prices is, of course, by their translation into contemporary wages or commodities. Two obols was the fee paid at this time to compensate a citizen for neglecting his business for a day in order to serve on a jury. Three obols at the end of the Peloponnesian War, when prices were rising, was the daily wage of a mason's assistant.[5] One obol would buy a little toy cart[6]; extravagant persons might pay 20 drachmæ for a cloak and 8 drachmæ for a pair of sandals, but these were "Bond Street prices."[7] A magical ring, an infallible protection against snake-bite, could be bought for 1 drachma, i.e. 6 obols.[8]

Sporting animals and the pets of the aristocracy ran into big prices. The hero of the *Clouds* of Aristophanes owed 12 minæ (1,200 drachmæ) for a race-horse,[9] and Alcibiades paid as much as 70 minæ for a dog, whose long and beautiful tail he proceeded to cut off, a prank to make people talk about him.[10] His extravagance may be measured by the price of slaves. At the sale of confiscated property belonging to Alcibiades and others, who were convicted in 414 B.C. of having blasphemously acted a parody of the sacred mysteries, the top prices for Syrian slaves were 2½ and 3 minæ, while Carian and Thracian slaves ran as low as 1½ minæ.[11]

Of our two favourite domestic animals, the dog and cat, the cat proper which the Greeks called "wavy tail" (*ailouros*) was indigenous in Egypt, and it is represented in Ægean Bronze Age art in designs adapted from Egyptian originals; but Herodotus devotes some space to its description as a foreign animal,[12] and it does not seem to have been a usual inhabitant of Greek houses. The Bœotian in the *Acharnians* who has already been mentioned speaks of having cats to sell,[13] but as a rule the marten cat (*galê*) seems to have been used in Greek houses to keep down the smaller rodents. The superstitious believed that it was bad luck if a *galê* crossed your path as you were going out.[14] But the Greek lived in the market place and not at home; the mouser in consequence played little part in his life and hardly figures in literature.

With the dog it was otherwise. Plato used his virtues to illustrate the characteristics required by the warrior class in his ideal republic,[15] but already in Homer we find him in his familiar aspects of the watchdog, the sporting dog, and the friend of man. Those who have travelled in modern Greece and have had to defend themselves with stones against the onset of the savage sheepdogs until their masters called them off will appreciate the truth of the picture of Odysseus's approach to the steading of Eumæus the swineherd: "And of a sudden the baying dogs saw Odysseus, and they ran at him yelping, but

[1] Theophrastus, *Characters*, vii (trans. Jebb). In a volume called *English Literature and the Classics* (Oxford Press, 1912) there is a paper by G. S. Gordon upon Theophrastus and John Earle and his other English imitators, which is well worth the attention of anyone interested in literature.

[2] Plato, *Lysis*, 211 (trans. Jowett). Cf. Xenophon, *Memorabilia*, i. 6, 14 (trans. Dakyns). As I have pointed out elsewhere (*Liverpool Annals of Archæology*, viii. 47), the coincidence between the two passages suggests that this is an authentic saying of Socrates'.

[3] Plutarch, *Life of Alcibiades*, 10.

[4] Aristophanes, *Birds*, 14, 18, 1077.

[5] Idem, *Ecclesiazusæ*, 310.

[6] Idem, *Clouds*, 861.

[7] Idem, *Plutus*, 982.

[8] Ibid., 884.

[9] Aristophanes, *Clouds*, 21.

[10] Plutarch, *Life of Alcibiades*, 9.

[11] Hicks and Hill, *Greek Historical Inscriptions*, No. 72. No doubt Syrians were more highly educated and therefore more expensive. After Alexander's conquests black slaves became fashionable with people of social pretensions (Theophrastus, *Characters*, vii), as they were afterwards in Rome [Tibullus, II, iii. 55 (Loeb Classical Library)], and in England in the eighteenth century.

[12] Herodotus, ii. 66 (trans. Rawlinson). An amusing account of why Egypt is not overrun with cats. The historian notices also the mummied cats of Bubastis.

[13] Aristophanes, *Acharnians*, 879.

[14] Theophrastus, xvi, *The Superstitious Man*.

[15] Plato, *Republic*, 375–6.

Odysseus in his weariness sat him down and let the staff fall from his hand. There by his own homestead would he have suffered foul hurt but the swineherd with quick feet hasted after them and sped through the outer door and let the skin fall from his hand. And the hounds he chid and drove them this way and that, with a shower of stones." [1] Telemachus walks into the market place at Ithaca with his two dogs at his heels.[2] Two of the nine "table dogs" which had belonged to Patroclus were slaughtered on his pyre to keep their dead master company.[3] But the most famous passage is that describing the passing of the old sporting dog which Odysseus had left a puppy when he sailed for Troy. Old Argos ("Swift"), lying neglected on the dungheap, hears the voice of his master, who, returning after twenty years of wandering, remains unrecognised by human beings, even by his nearest and dearest. "There lay Argos, full of vermin. Yet even now when he was ware of Odysseus standing by, he wagged his tail and dropped both his ears, but nearer to his master he had not now the strength to draw. But Odysseus looked aside and wiped away a tear." He learns from Eumæus the story of the dog's neglect since his departure, and "therewith he passed within the fair lying house, and went straight to the hall, to the company of the proud wooers. But upon Argos came the fate of black death even in the hour that he beheld Odysseus again in the twentieth year." [4]

In historical times dogs were sacrificed at Sparta and in Caria to the god of war. In Thrace Herodotus reports the settlement of a dispute between Perinthus and the Pæonians by a triple duel in which the champions fought man to man, horse to horse, and dog to dog,[5] and the people of Magnesia on the Mæander in Asia Minor are said to have trained dogs to fight with their heavy infantry.[6] But in Greece proper dogs were not used in war, and the only example known to me is that of the dog who accompanied his Athenian master in the Battle of Marathon (490 B.C.), and was immortalised in the famous picture of that victory over the Persian invader with which Polygnotus decorated the Painted Colonnade at Athens.[7]

Sporting dogs were used in hunting the boar and coursing the hare. For the former Xenophon recommends Indian, Cretan, Locrian, and Spartan breeds.[8] We may recall the famous description of an Elizabethan staghound pack which Shakespeare puts into the mouth of Theseus:

> "My hounds are bred out of the Spartan kind,
> So flewed, so sanded; and their heads are hung
> With ears that sweep away the morning dew;
> Crook kneed, and dew-lapped like Thessalian bulls;
> Slow in pursuit, but matched in mouth like bells,
> Each under each. A cry more tuneable
> Was never holla'd to, nor cheered with horn
> In Crete, in Sparta or in Thessaly." [9]

Dogs were used to protect private houses and were frequently attached to temples, which, apart from the valuables (plate, etc.) they contained, were also used as national banks. In the *Wasps* of Aristophanes the hero is obliged to keep his old father, who is in his second childhood, shut up to prevent him from indulging his passion for sitting in the law courts. The old man spends his time playing at law courts at home with the railing of the pig pen to make a court and the house dog, Labes ("Pincher"), to take the rôle of the accused.[10] Of temple guardians the most remarkable were those of the sanctuary of the native Sicilian god, Adranus. During the day-time they made themselves pleasant to all passers-by. At night they showed singular discrimination. To thieves they gave no mercy, but if they met any friends of the god, who were temporarily incapacitated by conviviality, they led them safely to their homes, at the same time intimating their disapproval of such immoral conduct by tearing their clothes and rolling them in the mud without otherwise hurting them.[11]

For lap-dogs the most favourite breed was the Melitean, affected, as we have seen, by the Man of Petty Ambition. They may have come originally from Malta, but perhaps more probably were native to the island of Meleda near Curzola in the Adriatic.[12] Little brown yapping creatures they seem to have been. Lucian gives a comic description of a Stoic philosopher named Thesmopolis, whose lady-love implores him to promise to do something for her. She wants him to take charge of sweet little Myrrine, who is not very well, poor darling, and the servants won't look after

[1] Homer, *Odyssey*, xiv. 29 (trans. Butcher and Lang).

[2] Ibid., ii. 11.

[3] Homer, *Iliad*, xxiii. 173 (trans. Lang, Leaf, and Myers).

[4] Idem, *Odyssey*, xvii. 290 foll.

[5] Herodotus, v. 1.

[6] Pollux, v. 47.

[7] Ælian, *Nat. An.*, vii. 38. I do not know of a modern English translation of this foolish but entertaining work. There is a Latin translation in the French Didot edition.

[8] Xenophon, *Cynegetica*, x. 1. The method of boar hunting was to track the quarry to its lair with a single hound; a Spartan bitch is recommended for this work. Cf. the mediæval tufting with a lime hound [Hamilton, *The Red Deer of Exmoor* (*Field* Office, 1907), 222 foll.]. Nets were spread round the covert and only then was the pack let go.

[9] Shakespeare, *A Midsummer Night's Dream*, Act iv, Scene 1. Our ancestors, and indeed our immediate forbears, paid more attention to music and less to speed than modern breeders of foxhounds. On the whole subject see that delightful book, Madden, *The Diary of Master William Silence.*

[10] Aristophanes, *Wasps*, 824 foll.

[11] Ælian, *Nat. An.*, xi. 20.

[12] The matter is discussed by Jebb in his notes on the passage in Theophrastus.

her properly. The unfortunate philosopher is compelled to make a fool of himself carrying the spoilt little Melitean dog, which peers, yapping, out of the fold of his cloak and keeps on licking his long beard.[1]

In general the attitude of the ancient Greeks towards the dog was very much our own. Prototypes of most of the familiar dog stories are to be found in the collection of anecdotes about animals made by Ælian, including the dog story of Sir Walter Scott's *Talisman*, and that of the faithful animal which refuses to survive its master.[2] There is no trace in Greece of the Semitic view that the dog is an unclean animal.

In religion it is therefore unimportant. Sacrifices of dogs to the war god have been mentioned; at Argos there was an obscure sacrifice of dogs in connection with the feast of Linus, a hero connected with the fertility of flocks and herds. From some shrines dogs were excluded, probably on account of their uncleanly habits. That they were attached to temples for protection has been noticed. They were used in midnight magical offerings at the cross-roads to Hecate, the goddess of magic and the underworld, and their howling was considered a bad omen. They were also closely attached to the god of healing, Asclepius, and in some of the miraculous cures recorded in the dedicatory tablets at his great shrine at Epidaurus the healing was effected through the licking of the patient by one of Asclepius's dogs.[3] That a dog's tongue has healing properties is a world-wide belief based upon observation of canine habits.[4] *Langue de chien, sert de médecine*, runs a French proverb. Their association with the god of healing is therefore readily intelligible, but it is remarkable to find, upon the unimpeachable authority of an inscription confirmed by a fragment of a contemporary comic poet, that at the beginning of the fourth century B.C. the Athenians offered sacrifice to the sacred dogs at a shrine of Asclepius and to the "dog leaders," who are more probably spiritual agencies of some kind than human guardians of the dogs. So crude a superstition is unique in the ritual of the state religion of its time and place.[5]

[1] Lucian, *De Merced. Cond.*, 34. There is an excellent translation of this author by the brothers Fowler published by the Oxford Press.

[2] Ælian, op. cit., vii. 25, 40.

[3] These are discussed in Frazer, *Pausanias*, iii. 249.

[4] See Gaidoz, "A propos des chiens d'Epidaure," *Revue Archéologique*, 3rd series, iv. 217.

[5] The matter has been discussed by Farnell, *Classical Quarterly*, xiv. 139 foll.

AMONGST other articles to appear in the July number of DISCOVERY will be the first instalment of a paper by Mr. Julian Huxley on *Sex and its Determination*; an account by Major W. T. Blake, the airman, who is participating in a round-the-world flight, of *The Progress of Aerial Photography*; and a narrative by Mr. Edward Liveing, compiled from various sources, of the fate of the poet Shelley, the centenary of which falls on July 8.

Fertility Rites in Modern Egypt

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RITES to ensure the birth of children are practically world-wide and they are of great variety. The failure of offspring involved the weakening of the tribe, which in early times was dependent on its numerical strength for its defence against hostile neighbours. Hence the importance of the possession of children, especially those of the male sex.

Love for their children is a marked trait in the character of the modern Egyptians. I have heard it asserted that an Egyptian man is seen at his best when among children, and my own observations have so far certainly borne out this statement. While visiting various villages in Upper Egypt, I have frequently attended to inflammation of the eyes and other lesser ailments of the inhabitants. On these occasions men, almost as often as women, have brought their children for me to see, with a view to asking my advice as to their health, and I have been struck by the gentle way in which they treated their little ones.

Under Muslim law a man may divorce his wife if she bears him no children. A woman divorced for this reason has but a small chance of obtaining another husband; hence the prospect of childlessness is a very real terror to her. The methods resorted to in order to prevent such a catastrophe are numerous.

Some years ago when I was working at a large collection of charms and various magical appliances at the Pitt-Rivers Museum in Oxford, it occurred to me that some so-called "pendants," which my brother had brought from Egypt and given to me, might have some "magical powers" attached to them. These "pendants" are modern copies of ancient Egyptian blue-glazed amulets, representing gods, goddesses, sacred animals or scarabs. I showed these objects to the Egyptian Sheikh then resident in Oxford and asked him what they were used for. After some hesitation he told me that they were women's charms and were used in Upper Egypt[6] as a means for producing children. He also told me that, in the event of a man travelling about that part of Egypt with these charms, the women would flock out of the villages to meet him in order that they might "jump" over them.

Soon after my arrival at Gebel Meir in Asyūṭ Province in the winter of 1920–21, a certain number of childless women sent appealing messages to me asking me if I could let them have a bone out of the large

[6] As a result of my personal researches in Egypt I have found that these charms are used very generally all over the country.

numbers, which had been dug up during the recent excavations of Seyd bey Khashbeh and lay scattered about the ancient burial site on which our camp was situated. Their object was to "jump" over the bone in order to ensure the production of offspring. I acceded to their request and then, of course, thought of my "pendants," which unfortunately I had forgotten to bring out to Egypt with me. However, I sent a message to the women to say that I had written to England, requesting that certain very potent charms that I possessed should be sent to me as soon as possible.

When the parcel arrived, I caused the fact to be known in the various villages of the district, at the same time intimating that I should be glad to see any of the women who wished to make use of them. From that time onwards, in order to take advantage of my offer, women, sometimes as many as ten at a time, would walk from their various villages across the lower desert up to our camp on the hills which rose into the upper desert. They were usually accompanied by a middle-aged man or woman, sometimes by both. The man was not present at the ceremony, but the woman chaperon stayed with them all the time.

The ritual was as follows: The women first repaired

FIG. 1.—A WOMAN IN THE ACT OF STEPPING OVER TWO OF THE BLUE-GLAZED AMULETS, OUTSIDE THE ROCK-CUT TOMB-CHAPEL WHERE THE AUTHOR LIVED.

to one of the ancient decorated tomb-chapels, accompanied by our servant, who had the key, and on entering they, one by one, stepped seven times backwards and forwards over what they supposed to be the mouth of the shaft admitting to the subterranean burial chamber. When all had thus performed, they returned to the undecorated tomb-chapel in which I

FIG. 2.—THE BLUE-GLAZED AMULETS.

lived. Here I produced the charms, two of which were placed on the ground at a time, and then were solemnly stepped over seven times, backwards and forwards, by each woman (Fig. 1). Four charms in all were used, representing the head of Isis, a mummiform divinity, a scarab, and a cat (Fig. 2). When this was accomplished, a lower jaw-bone of an ancient Egyptian was placed on the ground and a similar ceremony was gone through, this ceremony being also repeated in the case of two heads of the ancient inhabitants, one a well-preserved mummified head, the other a skull. A glass of water was then brought, into which the blue-glazed charms were dropped. Each woman drank some of the water, and then picked out the charms and sucked them. Some of the women also rubbed their bodies with these magical objects. Generally, especially when, as was often the case, I took my charms to women in the villages, each woman would have a separate tumbler of water into which the charms were placed, and, after drinking some of the water, sucking the charms, and sometimes rubbing herself with them, she took the remainder of the water and douched herself with it.

It may interest my readers to know that on my return to Egypt at the end of last year one of the first items of news communicated to me by my servant was that at least two of the women who had "jumped" over my charms and the ancient heads and jaw-bone would shortly present their husbands with a child.

I am told that great efficacy is attached to the pyramids, and that a childless woman will repair to one of them and walk round it seven times, believing that this will enable her to become a mother. Women sometimes beg to be allowed to remove small portions

of the decorated walls in ancient tomb-chapels as charms to ensure their bearing children. It appears that ancient things in Egypt are credited with great potency in this respect. It is difficult, if not impossible,

FIG. 3.—THE STONE WITH ITS "SERVANT" AT KUSĪYEH.

to obtain any reliable information from the people themselves as to why they attach so much magic to antiquities. Originally there may have been some belief in reincarnation—the stepping over the tomb-shaft and the bones suggest this—but there is also the idea that *baraka* is attached to anything that is old or sacred, or even peculiar. The word *baraka* means " blessing," and *barūka* is " a lucky coin," " a thing to bring good luck." This quality is often attributed to the tombs of Sheikhs, and such buildings are consequently visited by people who have some special request to make, hoping in this way to obtain a "blessing" or "good luck."

Women who have no children will sometimes visit a Sheikh's tomb entreating him to intervene on their behalf and vowing to make some return if their wish is granted. A cord or cords are often to be seen hanging across the inside of such a building, and from it are suspended a variety of objects, including coloured handkerchiefs. These are in many cases the votive offerings of women, which they have hung up in the tomb when their prayers for offspring have been answered.

Lane[1] records the practice of visiting tombs or mosques to obtain a blessing, or to urge some special petition, such as the gift of children. He states that the suppliants believe that a more favourable reception of their prayers will be granted them if offered up in such sacred places.

It has been recorded by Mrs. Haris H. Spoer,[2] that in Jerusalem childless couples will travel for considerable distances in order to visit and bathe in certain pools, and that " barren women visit the hot springs in various districts, not, as might be supposed, for any medicinal properties, but because the *jinni*, who causes the vapour, is regarded as a being capable, in a definite and physical sense, of giving them offspring." She adds, " Belief that women may have intercourse with disembodied spirits is common among Muslims " ; and I have also found the same belief existing among the peasants of the Fayūm.

Baraka is also occasionally believed to be possessed by, or attached to, living people. Over and over again women have come up to touch me because they believed I had this virtue. Babies were handed to me to hold in my arms for the same reason. As I generally manage to hush a squalling infant to sleep, their belief in me was strengthened, and they would say, " Ah, it is true ; she *has* got *baraka* ! "

It is a popular belief in Egypt that if a dead child is tightly bound in its shroud the mother cannot conceive again. Therefore the shroud is always loosened just before burial, dust also being put in the child's lap. If, in spite of the precautions, the woman, as time goes on, seems to have no prospect of again becoming a mother, she will go to the tomb of her dead child, taking with her a friend, who opens the tomb. The disconsolate mother then goes down to the place where the body lies and steps over it backwards and forwards seven times.

A somewhat similar practice has been noticed among the Bangalas, a tribe who live in Equatorial Africa, to the north of the Congo. On one occasion a woman of this tribe was seen to be digging a hole in a public road. Her husband explained to a Belgian officer who was present that his wife wished to become a mother, and begged that she might be left unmolested, promising on his part to mend the road afterwards. The woman continued to dig till she had unearthed the skeleton of her dead child, which she affectionately embraced, begging it, at the same time, to enter her body to be reborn.[3]

The last-mentioned Egyptian practice, viz. that of stepping over the dead child, is distinctly suggestive of a belief in reincarnation. Such a belief is indeed definitely averred in the account given of the strikingly

[1] *Manners and Customs of the Modern Egyptians.* London, 1895, pp. 246 ff. A cheap edition has been published in " The Everyman's Library " ; see same page therein.

[2] *Folklore*, xviii, 1907, p. 55, " Powers of Evil in Jerusalem."

[3] Quoted by Sir J. G. Frazer, *The Golden Bough*, "Adonis, Attis, Osiris," vol. i, p. 92.

similar practice from the Congo region, the mother, as we have seen, expressly requesting the spirit of her dead child to enter her in order to be reborn. Possibly in Egypt the people may have no concrete ideas on this point. The custom may have had its origin in an early and definite belief in rebirth, the ceremony being continued at the present day because it has become the custom and is one of the recognised devices resorted to as a cure for barrenness, while the belief which gave it birth no longer consciously exists in the minds of the people who practise the rite.

There is a belief in the Fayūm Province, and it may prevail in other parts of Egypt, that if a woman who has lately become a mother goes to see another woman who has recently given birth to a child which has died, the latter will not conceive again. Such a visit should not be paid till the child has been dead for fifteen days. Should such a meeting take place accidentally, the mother of the dead child must counteract this evil influence by visiting the child's tomb as described above.

Sometimes, if a woman has no children, her friends will take her to the railway and make her lie down between the lines in order that the train may pass over her. Again, a friend will bring a large lizard of the kind called *waran* for a childless woman to step over three, five or seven times. Yet again, the pollen of the male palm is mixed in water, which is then given to a childless woman to drink. All these are effective methods, it is believed, of inducing conception.

Particular stones, either those covering the body of a dead Sheikh, or those of large size or peculiar shape, are also visited by childless women. There is a stone in the centre of a field, just outside the village of El-Habalsa in Asyūṭ Province, which is frequented by the women for various reasons, one of them being for the purpose of securing offspring. The stone, which is roughly conical in shape and is of small size, is surrounded by whatever crops are being cultivated on that spot. It has been thus utilised by the women for a long time, one hundred years I was told, though this may be only a way of expressing a lengthy period. Men have often tried to dig it up, excavating to a considerable depth all round it, but they have never come to the bottom of the stone, according to my informant.[1] A certain mystery is attached to the stone because of this belief, thereby doubtless enhancing its magical value.

There is another very large stone at Ḳusīyeh, a town in the near neighbourhood of El-Habalsa. It stands in a field situated between two large burial grounds. Childless women are in the habit of visiting the stone and either walking round it or stepping over it seven times to enable them to have children. There is a woman called "the servant" of the stone who attends on such occasions and receives donations from the visitors (Fig. 3).

Just outside Dalga, a large village in Asyūṭ Province and lying close to the edge of the desert, is an erection of stones which covers the burial place of the Sheikh Abdu'r-Raḥmān (Fig. 4). A domed tomb formerly stood there, but it gradually fell into disrepair and in course of time nothing was left of it. The stones are placed over the spot where the body lies, in order to prevent passers-by from treading over the dead man. These stones are visited by childless women who walk round them seven times in the belief that by so doing their barrenness will be cured.

FIG. 4.—STONES COVERING THE BURIAL-PLACE OF THE SHEIKH ABDU'R-RAḤMĀN AT DALGA.

The water with which a corpse is to be washed is, if possible, obtained from a mosque. After the washing is completed a barren woman will "jump" over the water, i.e. step over it backwards and forwards, seven times. My informant [2] told me that he saw this done on one occasion, and the woman conceived a month afterwards.[3]

In all the cases mentioned above I have not found anything quite comparable with the belief, which many anthropologists assert is held by various primitive peoples, notably certain tribes in Australia, that the father has nothing to do with the genesis of the child ;

[1] Ibrahim Effendi Narūz, schoolmaster at Meir, to whom I am indebted for a good deal of valuable information on this subject.

[2] Hideyb 'Abd-esh-Shāfy of Illāhūn, Fayūm.

[3] Cf. E. W. Lane, *Modern Egyptians*, London, 1895, pp. 266-7.

indeed, in some instances, his co-operation was definitely alluded to as essential to it. On the other hand, I have quite recently come across certain ideas, current among the peasants of the Fayūm, which do point to a certain amount of ignorance in this respect, though not associated with the rites described in this paper.

Imperial Wireless Communications

By Lt.-Col. C. G. Crawley, R.M.A., M.I.E.E.

For several months past there has been an uninterrupted flow of articles, leaders, and letters in the Press on the subject of Imperial wireless communications, and the matter as a whole has become so obscured in clouds of controversial detail that it may be of interest now to take stock of realities, past and present, and hopes for a future.

Imperial wireless may be said to date from October 1900, when the Marconi Company started the erection of the first high-power station in the world, at Poldhu in Cornwall. Unfortunately the first check in the long list which has followed came within a year when the masts at Poldhu were wrecked by heavy gales in the autumn of 1901. The year 1902 was spent in making good this loss, and in further improvements, and on December 18 Mr. Marconi opened up a fresh page of history by sending a wireless message from the Cape Breton Station in Nova Scotia to King Edward VII in England. The following year, 1903, saw the institution of a regular wireless service to ships at sea, and in 1904 the first Imperial service was working, though far indeed from regularly, between this country and Canada. In 1905 the Marconi Company started the erection of a high-power station at Clifden on the west coast of Ireland, and in 1907 a commercial transatlantic service was opened between this station and Glace Bay in Nova Scotia.

It had thus taken seven years of unflagging hard work and resourcefulness, in face of what then seemed to many quite insurmountable obstacles, for Mr. Marconi and his small band of enthusiastic followers to forge the first link in our Imperial wireless communications.

During the next four years, on the practical side, the Clifden–Glace Bay service went on improving (but at a rate which gave no sleepless nights to shareholders in cable companies) ; and on the theoretical side, the idea of an Imperial system progressed equally slowly, until it culminated eventually in a decision at the Imperial Conference of 1911 to the effect that an Imperial wireless chain of stations should be erected without delay. In July 1912 the Postmaster-General entered into a contract with the Marconi Company for the erection of the chain. By this contract the Company were to erect stations in England, Egypt, East Africa, South Africa, India, Singapore, and Hong-Kong, the chain being extended from Singapore to Australia by the erection of a station by the Australian Government at Port Darwin. This was the scheme which gave rise to the bitter discussions which led to a Parliamentary Committee of Inquiry in the following year. A commencement was made with the construction of the English station at Leafield near Oxford, and of the Egyptian one at Abu Zabal near Cairo, but the outbreak of war in 1914 resulted in a change of policy, and this scheme of Imperial wireless intercommunication was dropped for a less grandiose one of Imperial wireless ship and shore communication. This latter scheme consisted of the erection of medium-power stations, primarily for ship work, at Jamaica, Bermuda, St. Johns (Newfoundland), Demerara, Aden, Mauritius, Durban, Port Nolloth, Bathurst (Gambia), Seychelles, Colombo, Singapore, Hong-Kong, as well as more powerful ones at Ascension and Falkland Islands. Jamaica and Bermuda stations were erected by the Admiralty, and the remainder on behalf of the Admiralty by the Marconi Company. These stations, along with a similar one erected by the Admiralty in the Azores (Portuguese territory), proved of great value during the war for the purpose for which they were designed, viz. communications with ships and occasional point to point strategic communications, but they were not powerful enough, nor could they be adapted for commercial working as an Imperial chain.

As soon as the war was over, and the Marconi Company had been awarded in the law courts over half a million pounds sterling as compensation from the Government for the abandonment of the larger scheme, the desirability of pushing on with some such scheme again became apparent, especially as the cables were much congested, and the consequent delays were seriously hampering the reorganisation of business throughout the Empire. In 1919 the Government decided to go on at once with the erection by the Post Office of the stations near Oxford and Cairo, and to appoint a Committee to go into the whole question of Imperial wireless communications. The Oxford station was opened last August, and has been used for various long-distance communications ; the Cairo one has just been completed, and the Oxford–Cairo service is now in operation.

The Committee appointed by the Government, the Imperial Wireless Telegraphy Committee, under the

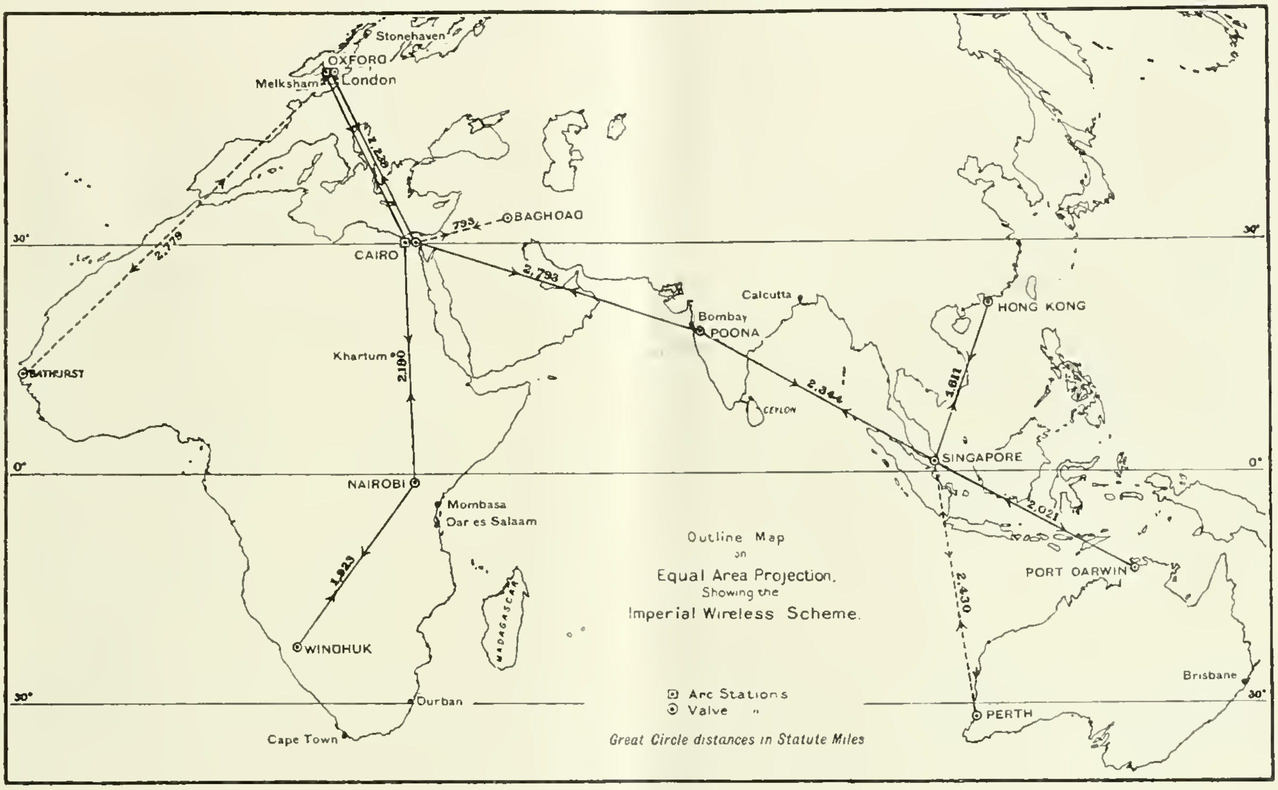
chairmanship of Sir Henry Norman, M.P., consisted of three independent wireless experts and four Government officials closely connected with the development of wireless and electrical science generally. This Committee's report, dated June 1920, was approved by the Government and by the Imperial Conference of last year, Australia, however, retaining full freedom of action as to the method in which she would cooperate.

The Committee's recommendations included:

(1) A chain to South Africa consisting of the present stations at Oxford and Cairo, a new station near Nairobi in Kenya Colony, and the ex-German station at Windhuk, South Africa (to be altered as necessary).

The Committee's report has given rise to criticism on two points: first, that the State is to erect and work the stations; secondly, that instead of having direct working between England, India, South Africa, and Australia, the scheme contemplates the use of intermediate stations.

As regards erection and ownership by the State, it has been urged that the chain could be erected more rapidly and worked more efficiently by private enterprise than by Government, and the success of such an arrangement in the case of our cable communications has often been referred to in this connection. The Committee, however, pointed out that an Imperial wireless system to work efficiently must be protected



Reproduced from the Report of Wireless Telegraphy Commission.

(2) A chain to Australia consisting of new stations in England, Egypt, Singapore, and Australia, with a branch to Hong-Kong from Singapore.

(3) A third station in England to communicate with Canada.

(4) The stations to be planned by a Wireless Commission of about four members, the constructional work being entrusted to the Post Office and the corresponding Dominion and Indian Authorities.

The Committee estimated that the total capital cost of the scheme, excluding the Canadian link and the existing Oxford–Cairo link, would be £1,243,000, of which £853,000 would fall on the Imperial Government.

from interference from other sources owing to the very limited number of "wave-lengths" available for long-distance working, and of these "wave-lengths," in any international agreement, only a proportion could be claimed for the British Empire. In other words, the Committee claimed that owing to the mutual interference which is so easily caused by the signalling of high-power wireless stations, any Imperial scheme must be, for all practical purposes, a monopoly, and though there might be objections to a Government monopoly, there were greater objections to a private monopoly. In the case of cables this monopoly question does not, of course, arise, as there is no mutual interference, and, therefore, no limit technically to the

number of competing cables that may be used for any one connection.

As regards the superiority of direct working between the main centres as opposed to utilising intermediate stations for passing on the messages, there can be no question. But the point is, whether stations can at present be erected in England, India, South Africa, and Australia to give economical direct working at all times. The Committee thought not, and proposed the use of intermediate stations.

Australia, however, has decided to erect a station which will obtain for the Commonwealth direct communication with the United Kingdom, and similar schemes for India and South Africa have been the subject of frequent communications to the Press.

The Commission for planning the Government stations was appointed in December 1920, and in their report published in January last it was made clear that they were in agreement with the views of the Norman Committee. The stations (shown on the map which illustrates this article) which they have planned for the main centres will be capable of direct working with one another, except during periods of unfavourable atmospheric conditions, when use will be made of the intermediate stations. For what average periods of the day and night this direct working will be practicable it is impossible to predict, more than to say that direct working between centres will be possible for several hours daily on the average, and that with the help of the intermediate stations an efficient commercial service will be available at all times.

Biology in Shakespeare II.

By D. Fraser Harris, M.D., D.Sc.

Professor of Physiology at Dalhousie University, Halifax, N.S.

(*Continued from the May No., p.* 134)

Before passing on to Shakespeare's allusions to the nervous system and to psychological considerations, we might notice some phrases which refer to subjects of distinct physiological interest. For instance, when it is said in *Richard II* (Act I, Sc. 3)—

> " Things sweet to taste prove in digestion sour "—

we have a remark in agreement with the latest results of physiological chemistry. The sugars, it is now believed, in being digested pass through a stage of lactic acid ; in other words a sour stage.

The exact physiological condition in starvation could not be put better than in the line in *Coriolanus* (Act IV, Sc. 2):

> " I sup upon myself, and so shall starve with feeding."

In inanition the body lives on itself, as it is said ; what is actually happening is that the heart and central nervous system are living on the fat and muscles of the body. The former two—the noble tissues—are living at the expense of the rest of the body ; it is, therefore, physiologically correct to say that in starvation there is feeding.

No less interesting than Shakespeare's allusions to the vascular system are those to the nervous. In his day, unlike ours, all emotional conditions were not at once referred to the cerebrum and so disposed of ; there was a complicated distribution of them amongst the various viscera. Even much later than Shakespeare's time the seat of the soul was held to be in the heart ; for instance, by Vico (1678–1774). Descartes assigned it to the pineal gland ; Van Helmont placed it in the pylorus or " pit " of the stomach. Although Aristotle said the soul was in the heart, other Greek thinkers placed it in the diaphragm (phrēn) ; hence " phrensy " (frensy), or madness of the soul ; hence also " phrenology," a discourse on the supposed localisation of things mental. From time immemorial emotions have been associated with viscera, as in the Old Testament, where bowels yearned, and in the New, where there were bowels of compassion. Everybody knows that the spleen was supposed to be the seat of anger ; and we yet speak of a splenetic, meaning an angry, man, and a " fit of the spleen," meaning one of rage.

Curiously enough, love was placed not in the heart but in the liver. Shakespeare adopts this localisation when he makes Pistol in the *Merry Wives* (Act II, Sc. 1) say that Falstaff loves Ford's wife " with liver burning hot."

We have seen that, whereas Aristotle placed the soul in the heart, Galen placed it in the brain ; and Shakespeare, if he consciously followed any school of thought, was Galenical rather than Aristotelean, for he makes Prince Henry in *King John* say of the King:

> " It is too late, the life of all his blood
> Is touched corruptibly, and his pure brain
> (Which some suppose the soul's frail dwelling place) "—

etc., as though it were not yet decided, although some supposed the soul to be in the brain.

Shakespeare certainly recognised the brain as the organ of consciousness or states of mind. This was by no means the commonly accepted doctrine in his time.

The Queen in *Hamlet* (Act III, Sc. 4) says, as the Ghost disappears—

> "This is the very coinage of your brain ;
> This bodiless creation ecstasy
> Is very cunning in."

In modern language this is a visual hallucination. The hackneyed words of Cassio in *Othello*, "O that men should put an enemy in their mouths to steal away their brains," is one more Shakespearean recognition of the brain as the seat of the reason.

In *Anthony and Cleopatra* there is another remarkable passage apropos of this subject, where Anthony says (Act IV, Sc. 8):

> "Yet have we a brain that nourishes our nerves."

We dare not read into this line all that is involved in our modern doctrine of the nerve-cells in the brain being the highest trophic realm for the nerve-cells lower down which in turn give rise to the nerves themselves. If, however, it does not mean this, it does not seem to mean anything: it appears to embody some profound truth.

Possibly one of the most remarkable of all the passages of biological significance in Shakespeare is in *Love's Labour's Lost*, where Holofernes, speaking of ideas, says:

> "These are begot in the ventricle of memory, nourished in the womb of pia mater, and delivered upon the mellowing of occasion."

Holofernes is a schoolmaster, and therefore presumably represents a learned man, and certainly here his allusions are sufficiently erudite to puzzle a good many fairly well educated people.

The "ventricle of memory" is a phrase borrowed from the Arabian doctors of medicine, who held that the brain possessed three cavities or ventricles in which the three subdivisions of the chief soul resided. The anterior was related to sensations, the middle to imagination, the posterior to memory. (Modern anatomists describe five cerebral ventricles.) These views were adopted by the theological Doctors of the Church in the Middle Ages. They were one of the beliefs against which Andreas Vesalius, the father of anatomy, particularly inveighed in his celebrated treatise, *De Corporis Humani Fabrica*, published in 1543. In dealing with the brain he wrote: "I wonder at what I read in the scholastic theologians and the lay philosophers concerning the three ventricles with which they say the brain is supplied." "He then," says Sir Michael Foster, "goes on to ridicule the views held by these philosophers, namely, that a front ventricle is the receptacle of sensations which, passed on to a second ventricle in the middle of the head, are there used for imagination, reasoning and thought, and that a third ventricle near the back of the head is devoted to memory." Shakespeare adopts the unscientific terminology of the pre-Renaissance writers in the matter of mental states related to cerebral ventricles.

The expression "nourished in the womb of pia mater" is certainly obscure. "Pia mater" is the name given by anatomists to the highly vascular, soft membrane which, closely investing the brain and central nervous system, conveys to it the nourishing blood-vessels. It does in a sense nourish the brain, and, therefore, metaphorically might be said to bring to development anything functionally related to the activity of the brain. Whether or not Shakespeare knew of the anatomy of this membrane it is impossible to determine; but assuming that ideas are "begot" in a cerebral ventricle, it would be permissible to continue the simile and regard them as nourished by the membrane that nourishes the organ of thought. The completion of the analogy between giving birth to a child and bringing forth a thought is, of course, thus made possible. The passage is very striking, and shows Shakespeare familiar at least with the anatomical terminology of his day.

The allusions in Shakespeare's writings to the activities, both normal and morbid, of the central nervous system are quite as interesting as those relating to the heart and blood-vessels. The symptom of giddiness is mentioned several times in the plays.

In *King John* (Act IV, Sc. 2), for instance, we have the line—

> "Thou hast made me giddy with these ill tidings."

Sudden violent emotion is very liable to produce giddiness; but few persons except those trained in physiology could explain exactly how this is so. The emotion, usually of an unpleasant kind, arises on its physical side as an excitement of certain cells of the cortex cerebri; these cells discharge impulses to the nerves of the heart which have the effect of making the heart-beats ineffective (inhibiting them) for driving enough blood to the brain and central nervous system. The result of this is a general lowering of blood-pressure, so that the cells of the central nervous system, whose duty it is to innervate the muscles engaged in balancing the body, do not now get sufficient blood. The body, therefore, sways and tends to fall, and the subjective sensation accompanying this disturbance of equilibrium is a feeling of giddiness. Cerebral anæmia, in short, produces giddiness. It also produces loss of function in the cerebral sensory centres, and chiefly in the centre for vision, so that the person affected suffers from imperfect sight. This is interestingly noted in *Henry IV* (Part II, Act IV, Sc. 4), where King Henry says:

> "And now my sight fails and my brain is giddy"—

Shakespeare correctly attributing the giddiness to the organ involved. Shakespeare has not failed to note the subjective sensations which a giddy person experiences when stable, external objects seem to be moving round him and particularly in the direction opposite to that towards which he last moved. Thus we have in *The Taming of the Shrew* (Act V, Sc. 2)—

> " He that is giddy thinks the world turns round."

Hamlet (Act III, Sc. 4) makes a remark in reference to the functional activities of the nervous system of so profound a character that we hesitate to believe that Shakespeare really knew all it involves :

> " Sense, sure, yon have,
> Else you could not have motion."

The principle that sensory impressions must precede motor in the education of the nervous system is now regarded as of immense practical importance. It is a fact which, of course, could not have been known to Shakespeare that those tracts in the central nervous system which subserve sensation are developed functionally a considerable time before those which subserve movement. Shakespeare's marvellous observation had, however, shown him the truth of this important generalisation without the possibility of his having had any acquaintance with the physiological bases for it.

As one would be prepared to believe, the more exclusively the topic has to do with the human mind, the more penetrating is Shakespeare's treatment of it.

The oftenest quoted example of this is the psychic blindness of Lady Macbeth :

> " *Doctor :* You see her eyes are open.
> *Gentlewoman :* Ay, but their sense is shut."

That the eyes are open is not enough to ensure vision unless the centre for vision in the brain is also in activity is the physiology underlying this passage.

It is a state of mind-blindness, the result of extreme abstraction of the attention, a condition analogous to the state of the brain in hypnotism where a person can by suggestion be made blind although his eyes are open. Lady Macbeth is described as " fast asleep " but with open eyes. This is not natural sleep, for in it the eyelids aie always closed. Shakespeare correctly describes a condition popularly called " trance," in which, although the eyes may be open, there is no vision in the unconscious brain behind them.

Shakespeare clearly believed the brain to be the organ of the formation of images or ideas. One more example of this may be given from the *Merry Wives* (Act IV, Sc. 2) :

> " *Ford :* Well, he's not here I seek for.
> *Page :* No, nor nowhere else, but in your biain."

Coloured after-images or, as some call them, the results of retinal fatigue, are also alluded to in one of the plays. In *The Taming of the Shrew* (Act IV, Sc. 5) Katherine says :

> " Pardon, old father, my mistaking eyes
> That have been so bedazzled with the sun
> That everything I look on seemeth green."

This is a literal experience known to many : if the eyes are over-stimulated by exceedingly bright sunlight and one goes indoors suddenly, everything takes on a rather ghastly greenish hue.

A very striking passage involving biological interest we may take from *Hamlet* (Act I, Sc. 5), where the Ghost remarks :

> " The glow-worm shows the matin to be near,
> And 'gins to pale his uneffectual fire."

A minor point of interest is in connection with the paling of the light because of the dawn. The light of the glow-worm, in common with all lights, would begin to appear paler as the morning daylight increased. More technically, the light of the glow-worm is relatively feeble owing to the stimulation of the retina by a much intenser light. It is the same phenomenon as the extreme paleness of the moon's light when seen during the day. But there is a much more interesting word in this passage—the word " uneffectual " as applied to the " fire " or light of the worm. Surely Shakespeare means to convey the notion that the " fire " of the glow-worm is uneffectual because it is unaccompanied by heat. Now the fact has been established only quite recently that, when organisms emit light by an oxidative process known as chemiluminescence, the chemical energy is used directly for conversion to light-energy without passing through the stage of heat. In this sense, then, the light of the glow-worm is an uneffectual fire, because, being accompanied by no heat, it could set fire to nothing. Fire that will not set fire to anything is indeed uneffectual.

It need hardly be pointed out that it is only Nature that has succeeded in producing light without heat. Man has never yet achieved what he so greatly desires, a source of light without an accompanying very high temperature, for the heat generated along with light is wasted energy as far as illuminating purposes are concerned. The spectrum of animal light shows it to be devoid of vibrations both towards the red and the violet end of the spectrum ; it is, therefore, chemically (photographically) inert, which is another aspect of its ineffectiveness.

But this is not the only Shakespearean allusion to the glow-worm, for Pericles says (Act II, Sc. 3) :

> " Where now his son's like a glow-worm in the night,
> The which hath fire in darkness, none in light."

The principle in the physiology of the senses alluded to here is the well-known one of the inability of the retina to perceive so feeble a light as that, for instance, of a star in broad daylight. Hence, too, the light of the fire viewed in sunlight makes so feeble a visual impression that the popular belief is that the fire actually goes out on account of the sunlight. The explanation of the invisibility or feebleness of lesser lights in presence of greater is that the retina, already being fully stimulated, is not able to yield any additional response. As it is already doing so much, it is, relatively to any additional stimulus, in the state known as functional inertia.

One more fact in the physiology of the eye is illustrated in the same play when Achilles says :

> " Eye to eye opposed
> Salutes each other with each other's form."

This probably alludes to the seeing of oneself reflected in the eye of another. The images so produced are known in physiology as the Purkinje-Sanson images : the cornea of each eye acts as a convex mirror for the other person.

Let us close with three allusions of much interest to surgeons.

It is well known to surgeons that a broken bone healed by the callus which grows between the two ends at the fracture is much stronger than it was before. This is alluded to in *Henry IV* (Part II, Act IV, Sc. 1), where the Archbishop of York says :

> " If we do not make our atonement well,
> Our peace will, like a broken limb united,
> Grow stronger for the breaking."

The lines from *Othello* (Act II, Sc. 3)—

> " How poor is he that hath not patience,
> What wound did ever heal but by degrees "—

show that the chief characteristic of a healthy healing wound had been appreciated by Iago.

The lines in Hamlet's speech (Act III, Sc. 4)—

> " (Mother, for love of grace,
> Lay not that flattering unction to your soul,
> That not your trespass, but my madness speaks),
> It will but skin and film the ulcerous place,
> Whiles rank corruption, mining all within,
> Infects unseen "—

could hardly describe better the condition of a certain kind of wound, troublesome to the surgeon at all times, but particularly to-day when nothing is allowed to remain septic.

Reviews of Books

A NEW ACCOUNT OF THE PALÆOLITHIC PERIOD

A Text-book of European Archæology. By PROF. R. A. S. MACALISTER, Litt.D., F.S.A. Vol. i. : " The Palæolithic Period." (Cambridge University Press, 50*s*.)

Professor Macalister has written one of the best books on Archæology in any language. No one could possess better qualifications for the task he has set himself and in part accomplished. He is a Scotchman, whose practical experience was gained in Palestine, and who now lives in Ireland ; and he combines brilliant imagination with sound judgment.

The first volume consists of 610 pages, 184 illustrations, and a good index. The first chapter is introductory ; the next two deal with geology and palæontology, so far as these concern the student of human evolution. Chapter IV is an admirable and most readable summary of the methods of his science. The next four deal with the palæolithic period. Chapter IX is called " The Psychology of Palæolithic Man." Chapter X concludes the descriptive part of the volume with an account of the Mesolithic Period—that shadowy border-line between the Old and the New. The last chapter is a summary of " The Palæolithic Period as a Whole." In some ways the first four chapters are the best in the book ; they certainly make the best reading, for in writing them the author has been able to give free rein to his literary powers. They have obviously been written with enjoyment ; that is doubtless the secret of their success, for there is no pleasure in reading what has obviously been written only from a sense of duty. They reveal the author as an original thinker, whose point of view is essentially sane, but not always orthodox ; and as one who has little use for the mere collector, the " tea-party " archæologist, or the crank.

The author passes his many tests with flying colours. One of these is that of the Galley Hill skeleton—a " victim," as he says, " of the eager competition of collectors." To base important conclusions on a skeleton whose " gisement " was imperfectly observed is unscientific ; and Professor Macalister is rightly sceptical as to the great age attributed to it by some authorities. This discovery, made in 1888, is a crucial instance of the principle that in archæology it is not *what* is found that is of value, but *how and where* it is found—in what kind of soil, disturbed or undisturbed, and so on.

It would be tedious in a review to follow our author down the chilly corridors of the Ice Age, though his account of them is fresh and stimulating. The earlier part of the Palæolithic Period—from the Chellean to the Mousterian—seems to have been rather a " dull " time in human history. At any rate we confess to finding the latter part more attractive—the cave paintings, the fine flint craftsmanship, and the men themselves who mark the dawn of a new epoch. Still more fascinating is that earliest glimpse of modern times, which reveals new races beginning to arrive from the mysterious east, bring-

ing with them new arts, new customs, and, doubtless, a new religion. We may be sure that the domestication of animals was one of these, and it is in his imaginative description of the process that Professor Macalister stands out as first and foremost a prehistorian who has had the opportunity of living amongst primitive peoples and profited by the experience. "The beginnings of the domestication of animals," he says (p. 520), "were probably quite simple and commonplace. To some extent I have seen the process re-enacted for myself, when encamped in the Judæan wilderness. Some wretched starving half-jackal cur creeps stealthily up to the refuse heap and roots for bones, watching warily the while for the expected stone. The master of the encampment is, however, for the moment in a good humour. He has for once dined well, and in a fit of idle joviality he throws, not a stone, but another bone, to the visitor. The grateful beast, which has sprung aside with an anticipatory yelp, is taken by surprise at the unexpected favour, and creeps a little closer into the confidence of the encampment. At night, some thief or enemy comes to surprise the camp, and the dog rouses the sleepers in time to defend themselves. Thus the use of a watch dog is discovered, and the animal becomes permanently attached to the settlement. After a time he begins to accompany the man who is now his master on hunting expeditions, and there proves himself of further use."

The book has two unfortunate lapses—the maps on pp. 263 and 277. Many of the places are in the wrong position and the rivers are very inaccurately drawn. The Blackwater, for instance, is made a tributary of the Wey, and the Kennet Basin is entirely wrong in nearly every detail. The map on p. 277, where the Wylye is miscalled the Nadder, is no better. These, however, are matters which can easily be set right in a new edition.

O. G. S. C.

COMMUNICATION WITH SPIRITS

The Survival of the Soul and its Evolution after Death. By Pierre-Émile Cornillier. (Kegan Paul, Trench, Trübner & Co., Ltd., 10*s.* 6*d.*)

When we are presented with a phenomenon such as communication with the dead, which is at variance with our common experience, we tend to adopt towards it an attitude of incredulity that has in it something of hostility because, it might be supposed, the new idea is a challenge to our faith in the "continuity of phenomena," and to accept it would mean for us a new adaptation to reality.

Such an attitude is probably instinctive, and would seem to serve a useful purpose in stabilising society, since it prevents the adoption of new ideas before their value has been conclusively proved, but it has the disadvantage of hampering criticism; the new ideas are defended with embittered and often indiscriminate zeal by their prophets, and what is true may be obscured by a multiplicity of fallacious "evidence." And to this particular question of communication from the dead some special unconscious resistance seems to be provoked, for primitive man everywhere looks upon his dead as at least potentially hostile, and the burial rites all the world over have a common object in placating the spirits of the departed or preventing their return. No wonder, then, that attempts to recall the dead have been proscribed as necromancy, or as spiritualism have been opposed with mingled uneasiness and derision, for something of the old primitive feeling still survives.

Much spiritualistic evidence has been exposed as fraud and much is pathetically slender, built up by the recorder to sustain a belief in the continued existence and happiness of some lost friend or relative. But M. Cornillier's work comes under neither of these headings; it would be an impertinence to suspect the good faith of the author, and his medium gained nothing from the *séances*, nor, for the most part, were the "spirits" who appeared known to anyone concerned.

The medium was a girl of eighteen, an artist's model by profession, and in a state of deep hypnosis induced by the author she appeared to see and speak with a number of spirits, chiefly with a venerable old man who dictated to her an account of the life after death, confirming the views held, we believe, by the theosophists; and, if we do not accept these views, at least they do not flagrantly outrage our sense of inherent possibility. In addition to exhibiting spiritualistic manifestations, the medium appeared to visit and to be able to describe towns and houses unknown to her and sometimes imperfectly known to the author. The spirits spoke of many subjects, including music and musical composition, with which the medium in her waking state appeared to be completely unacquainted, for her education was very limited and her tastes and outlook of the simplest.

If we do not uncritically accept an external, i.e. a spiritistic, agency for these results, with its momentous implications, we must seek to analyse them into terms of the already known, which is the normal, if (as some critics assert) the limited, method of scientific investigation. If we rule out conscious fraud and telepathy, which, even were it tenable, would prove in this case an inadequate explanation, there seems to remain only the question of whether we are dealing here with the expression of part of the unconscious self of the medium that has become dissociated from the rest of the personality. Without a detailed psychological examination of the medium such an hypothesis can only be very tentatively advanced, but we feel that we are perhaps justified in saying that the specific grounds upon which the author rejects it are not altogether adequate. He says that the medium ". . . is not a hysterical subject. She is . . . of clean constitution with no organic weakness." Yet it is not impossible that the dissociation of personality, if it existed, might have found its only obvious expression in the mediumistic state and the occasional hallucinations and trance-like conditions that seem to have occurred spontaneously, nor does the phenomenon of dissociation imply quite so deep a stigma of functional disease, still less of organic, as the author seems to suppose. Sir Thomas Browne wrote, "I am no way facetious, nor disposed for the mirth and galliardize of company; yet in one dream I can compose

a whole Comedy, behold the action, apprehend the jests, and laugh myself awake at the conceits thereof." Had he had such a collaborator as M. Cornillier, these remarkable comedies might have been secured for posterity, and without, we think, exposing their author to any very severe reproach of mental disease.

On the other hand there are indications—slight, it is true—of possible psychological abnormalities in the medium. The extreme readiness with which she passed into a state of deep hypnosis is a condition that is almost always found where there is a considerable dissociation of personality, and it is also to be noted that although she was eighteen she had " the air of a child of fifteen," and it is as a " child " that the author always refers to her.

It is interesting and perhaps significant that the chief spirit who appeared, the venerable old man, soon came to fill for the medium the rôle of an ideal father ; he was protective and affectionate and he gave useful advice about the practical details of her daily life ; she became very attached to him, and he seems almost to have replaced her real father, who was an alcoholic and a hopeless ne'er-do-well. The data given in the book are naturally not sufficient, nor of a nature, to provide a psychological explanation adequate to account for the very remarkable results recorded, but it is to be hoped that some day the spiritualistic phenomena may be thoroughly sifted and, when all results attributable to deception and unconscious expression have been excluded, we may perhaps look for some valuable addition to our knowledge in the residuum that remains.

F. A. H.

MISCELLANEOUS BOOKS

Mr. J. M. Keynes has written a sequel to his *Economic Consequences of the Peace*. His new work, *A Revision of the Treaty* (Macmillan & Co., Ltd., 7*s*. 6*d*.), advocates the following proposals for the economic settlement of Europe : " (1) Great Britain, and if possible America too, to cancel all the debts owing them from the governments of Europe, and to waive their claims to any share of German reparation ; (2) Germany to pay 1,260 million gold marks (£63,000,000 gold) per annum for thirty years, and to hold available a lump sum of 1,000 million gold marks for assistance to Poland and Austria ; (3) this annual payment to be assigned in the shares 1,080 million gold marks to France and 180 million to Belgium." Other books lately published and dealing with international problems are *The New World*, by Dr. Isaiah Bowman, Director of the American Geographical Society of New York (G. C. Harrap & Co., Ltd., 21*s*.), who has compiled a vast amount of information about the world's post-war political geography, and an admirably lucid and scholarly account of *Foreign Governments at Work*, by Mr. Herman Finer (Humphrey Milford, Oxford University Press, 2*s*. 6*d*.), in which a valuable chapter is devoted to Germany's new constitution.

The centenary of Pasteur's birth takes place in December of this year. We recommend those interested in the great scientist's work to read the new biography translated from the French of M. Descour, *Pasteur and His Work* (T. Fisher Unwin, Ltd., 15*s*.). The impression which it, and indeed any biography of this pioneer, leaves upon the reader's mind is the orderly and progressive way in which every field of experiment which he entered led him on to another. After extensive studies of crystallography, Pasteur became a professor at Lille, " where the manufacture of alcohol from beetroot was one of the chief industries of the locality." The leading chemists of the day believed that the fermentation which produced this alcohol was entirely due to chemical action. Pasteur's work on crystallography made him sceptical of this belief, and in endeavouring to prove its error " he discovered the laws of fermentation and recognised the real nature of ferments." Thence he was led on to the discovery of anaerobes and to a " complete explanation of the dissolution of organic matter." Work followed on the origin of ferments, which was found of great help in meeting the epidemics that were then ruining sericulturists and which resulted in remarkable discoveries in human pathology. He " studied successively, or simultaneously, anthrax, the vibrion-septique, the microbes of osteomyelitis and puerperal infection, chicken-cholera." It was work on the microbe of this last disease which promoted his most famous scientific triumph—vaccination.

Books of exploration and travel never cease to appear in great numbers. There is such little distinction about many of them that we welcome two, widely divergent in subject, that have lately appeared. The first is written by a well-known Alsatian theologist, musician, and doctor, Professor Albert Schweitzer, who gave up his professorship at Strasbourg to do medical work in Equatorial Africa in the valley of the Ogowe River, which flows into the Gulf of Guinea. His account of his experiences amongst the natives and of the good and bad effects of Western civilisation upon them give one food for thought, and we intend reviewing his book, *On the Edge of the Primeval Forest* (A. & C. Black, Ltd., 6*s*.), at some length in an early subsequent issue. This remark also applies to Stefansson's *The Friendly Arctic* (Macmillan & Co., Ltd., 30*s*.). Stefansson led the Canadian Government's Arctic Expedition, 1913–18. Despite the daring of his adventures, he makes a striking case for the North as a " country to be used and lived in just like the rest of the world."

From time to time we receive astounding pamphlets on *Evolutive Education* from the " Los Angeles Co-operative Information Center for Evolutive Education." The latest pamphlet tells us of various new sciences, two of which are described as follows : " Embryogenetics is expressive of Mind, impulses and reason, and thus of the functional Principle. Ethereogenetics is expressive of Soul, emotions and intuition, and thus of the interacting Principle. It becomes necessary to advance such Super-sciences to the underlying neuro-motor, nervo-motor, muscular-motor and movement-motor *Combustion-processes* of different nature and importance. Internal Combustion is considered triune : *physical combustive, embryonal combustive and galvanic combustive*." And so on *ad lib*. Evidently Charles Chaplin is not the only humorist who lives in Los Angeles.

Books Received

(Mention in this column does not preclude a review.)

LANGUAGE AND LITERATURE

A History of Modern Colloquial English. By PROF. HENRY CECIL WYLD. Second Edition. (T. Fisher Unwin, Ltd., 25*s.*)

MISCELLANEOUS

The Yearbook of the Universities of the Empire, 1922. Edited by W. M. DAWSON, and published for the Universities Bureau of the British Empire. (G. Bell & Sons, Ltd., 7*s.* 6*d.*)

The Apple-Tree. By L. H. BAILEY. (The Open Country Books published by the Macmillan Company, New York, 7*s.*)

Materials for the Study of the Apostolic Gnosis. By T. S. LEA, D.D., and F. B. BOND, F.R.I.B.A. In two parts. (Oxford: Basil Blackwell, 6*s.* each part.)

The Evolution of Civilisation. By LORD CLIFFORD, F.G.S., etc. (The Evolution Society, 67 Madeley Road, Ealing, W.5, 5*s.*)

PSYCHOLOGY AND PSYCHICAL RESEARCH

Introductory Lectures on Psycho-Analysis. By PROF. SIGMUND FREUD, M.D., LL.D., Vienna. Trans. by Joan Riviere. With a Preface by Ernest Jones, M.D. (George Allen & Unwin, Ltd., 18*s.*)

Revelations of a Spirit Medium. By H. PRICE, F.R.M.S., and E. J. DINGWALL, M.A. (Kegan Paul, Trench, Trübner & Co., Ltd., 7*s.* 6*d.*)

A Unique Heathen, to which is now added Theodore Schroeder on the Erotogenesis of Religion. NANCY E. SANKEY-JONES. (Cos Cob, Conn, U.S.A.)

SCIENCE

Einstein and the Universe. By CHARLES NORDMANN. Trans. by Joseph McCabe. With Preface by the Rt. Hon. The Viscount Haldane, O.M. (T. Fisher Unwin, Ltd., 10*s.* 6*d.*)

A Criticism of Einstein and His Problem. By W. H. V. READE, M.A. (Oxford: Basil Blackwell, 4*s.* 6*d.*)

The Structure of the Atom. By STEPHEN MIALL, B.Sc., LL.D. (Benn Brothers, Ltd., 1*s.* 6*d.*)

Calculus and Graphs. By PROF. L. M. PASSANO. (New York: The Macmillan Company, 9*s.*)

Protein Therapy and Non-Specific Resistance. By WILLIAM F. PETERSEN, M.D. With an Introduction by Prof. Joseph L. Miller, M.D. (New York: The Macmillan Company, 21*s.*)

Pasteur and His Work. By L. DESCOUR. Trans. by A. F. and C. H. Wedd, M.D. (T. Fisher Unwin, Ltd., 15*s.*)

Correspondence

THE INVENTION OF THE PILOT CABLE

To the Editor of DISCOVERY

SIR,

Mr. George Frederic Lees contributed to the March number of DISCOVERY an extremely interesting article on Wireless Navigation and Nocturnal Flight, in which certain ingenious devices of M. Loth were described. In this article mention is made of "M. Loth's first invention, that of the cable guide for ships entering difficult harbours," and the writer proceeds to give "a short account of this electrical discovery which is already being exploited commercially." Now the Leader Cable, which is the recognised English name for what the French call the Cable Guide, was used by our own Admiralty during the war, while the system itself was invented and used experimentally as early as 1891 by Charles A. Stevenson, F.R.S.E., M.Inst.C.E., Ass.M.Inst.E.E. Mr. Lees is evidently wholly ignorant of Dr. Drysdale's Kelvin Lecture on "Modern Marine Problems in War and Peace," published in the *Journal* of the Institute of Electrical Engineers in July 1920, and of a later article in *Nature* of February 10, 1921, where the use of the Leader Cable is fully explained. In both of these articles Prof. R. S. Owen of McGill University is mentioned as having devised the same system in 1901 or 1903. My purpose, however, is to bring out clearly the fact that to Mr. Stevenson we owe, not only the first conception of the method and the first practical demonstration of its efficiency, but also the first published description of it. In 1891 he exhibited his apparatus in action to the Commissioners of the Northern Lighthouses, his express purpose being to lay an electric cable from a port to the open sea so as to pilot vessels into harbour. The method was described in a paper read before the Royal Society of Edinburgh on January 30, 1893, and published in that Society's *Proceedings*, vol. xx, 1892–95, p. 25. Meanwhile he had taken out a patent for the Pilot Cable, of which more hereafter. He continued working at the problem with practically no encouragement from others, and in *Nature* of December 31, 1896, he stated as an experimental result that signalling was effective at 200 yards distance from the cable. This was before the days of sensitive electrical detectors. In 1897 Mr. Stevenson constructed a working model representing his system in action on the French Coast in the neighbourhood of Ushant, and showing how a protecting cable could be used electrically to warn vessels (provided with suitable detectors) when they were approaching a dangerous shore. The model is still on exhibition in the Royal Scottish Museum, Edinburgh.

I propose now to reproduce the description given in Mr. Stevenson's patent of 1893 and compare it with the corresponding section in Vice-Admiral Fournier's Report on M. Loth's work to the French Academy of Sciences last year. The complete Specification of Mr. Stevenson's patent, which was accepted on March 4, 1893, is as follows:—

"A Means of Indicating Electrically the presence of a Coast, Rocks or Shoals, or determining a Ship's Position in a River, Estuary or Sea.

"Charles Alexander Stevenson, Civil Engineer, 84 George Street, Edinburgh, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

"My invention consists of an entirely new method of warning vessels electrically of their position or of their approach to a coast, shoal, mines or other danger. The apparatus consists of a submarine wire or wires, laid down in the bed of the sea, river, or estuary or out to any danger or anchorage or safe channel, through which intermittent currents are made to pass or the electrical state of which is made to alter by means of some form of electrical machine, generator or battery. These currents or changes of electrical state are detected by means of a detector of such currents or of the change of magnetic influence, or whatever it may be called, in the neighbourhood of the wire or wires through which such currents are made to flow, which detector may be on the ship or let down by rope or cable or coiled round the hull of the vessel. Whenever, therefore, a vessel comes into the neighbourhood or over the top of the wire those on board can detect its presence, and in consequence can locate their position. The currents have, if desired, different characteristics just as lighthouse apparatus has."

There then follows the description of a particular method which had been successfully tried.

In his report to the French Academy of Sciences (see *Comptes Rendus*, T. 175. 1921, p. 1231) Vice-Admiral Fournier, after a short introduction regarding M. Loth's inventions (*créations*), gives "the enumeration of his various inventions" under five headings, of which the fifth, literally translated, is as follows:—

"5. Solution of the problem of the guidance of ships at their entrance into a port and at their exit in time of fog and in time of war, during the night with harbour lights extinguished, by means of a 'cable guide.' This cable stretched out on the bottom of the sea is traversed by an alternating current of musical frequency (600 or 1,000 periods per second). This current generates in the surrounding space a variable magnetic field of specified type. The form of this field varies with the frequency. Its lines of force cut through the surfaces of fixed coils (cadres) placed on board and beneath the ships and disposed, according to the special form of the field, in such a manner that every vessel, without other means of guidance may know at each instant: (1) the direction of the cable; (2) the inclination of its course to this direction; (3) its distance from the cable and the side on which it follows it."

The systems described in these two quotations are fundamentally the same. It can hardly be questioned that Vice-Admiral Fournier in his report to the Academy of Sciences credits M. Loth with the solution of a problem which had been solved by Mr. Stevenson in essentially the same way twenty-nine years ago.

The Council of the Royal Society of Edinburgh have already drawn the attention of the Academy of Sciences to the historical inaccuracy of the statement made in Vice-Admiral Fournier's report, an inaccuracy which is reproduced with greater definiteness in the article contributed by Mr. Lees, who even goes the length of using the French name "cable guide" for the recognised English name "Leader or Pilot Cable."

M. Loth undoubtedly deserves the highest praise for the beautiful and sensitive devices which the modern development of electrical science has enabled him to make. Compared to these the early methods used by Mr. Stevenson cannot but appear primitive. But that in no way detracts from him the credit that is his due as the inventor of the "Pilot or Leader Cable." The Council of the Royal Society of Edinburgh regard it as a matter of simple justice that these facts should be known.

Yours, etc.,

C. G. Knott,

General Secretary,

Royal Society of Edinburgh.

April 20, 1922.

[Unfortunately this important letter from the Royal Society of Edinburgh arrived too late for us to send to Mr. G. F. Lees for his reply, which we hope to publish in our next issue.—Ed.]

THE PROBLEM OF PERSONALITY

To the Editor of Discovery

Sir,

You are to be congratulated upon the balanced attitude you assume in your editorial notes in the April issue of Discovery. Your recognition that physiologist and psychologist are working from different angles is one that is worthy of every consideration, and there is no question that it is impossible for us to arrive at any solution of the problem of personality unless we regard the whole matter from every possible point of view and take all the facts into account. The trouble is that most of us are far too anxious to establish a theory and so are apt to recognise only such facts as support our theories, ignoring all others. The materialist is especially subject to this trouble and does not seem to think it possible that his facts are capable of any other than a materialistic interpretation.

Your strictures on Dr. Berman's book, *The Glands Regulating Personality*, are well merited by that author. The very assertiveness and "cocksureness" of this author are sufficient to discount his conclusions among men who realise the immensity of the problem and its many aspects. Personality is certainly more than a matter of glands, no matter how the latter may affect its operation. It seems to me that it is becoming increasingly impossible for us to conceive of personality in any other terms than those of mind, and to think of the body as any other than an ultimation of personality and the mechanism through which it is expressed. The crude materialism which gave rise to the statement that the brain secretes thought as the liver secretes bile, is now untenable in the light of psychological research.

With regard to the ductless glands, I wonder if modern workers have paid any attention to the remarkable work of Swedenborg dating from more than 150 years ago. I shall satisfy myself with pointing out that this patient student, by his wonderful deductions, anticipated many of the pre-eminent offices of the ductless glands, which the physiologist of to-day is just beginning to discover. This appears from a paper read by David Goyder, M.D., at the International Swedenborg Congress held in London

in 1910. Any reader desirous of studying the history of work on these glands should study this paper, which is printed in the published Transactions of the Congress and may be obtained from the Swedenborg Society, 1 Bloomsbury Street, W.C.1.

Yours, etc.,
CHARLES A. HALL.

WOODBURN, CLYNDER,
DUMBARTONSHIRE.
April 15, 1922.

To the Editor of DISCOVERY

SIR,

The value of Dr. Berman's book is its provocative character. In the case of the writer of the editorial comments in the April DISCOVERY it seems to have worked very well. The thesis of the book is at page 103 under "The Vegetative Apparatus." If the statements here made can be disproved by biologists, the fact can be stated in a few words.

I am informed that the demand for the book has outrun the supply. I suggest your contributor should try again and go one better. To belittle Dr. Berman's effort while refusing to consider genuine scientific work now being carried on in our midst does not make for enlightenment.

Yours, etc.,
(MRS.) ELIZABETH MCLACHLAN.

147 HARLEY STREET,
LONDON, W.
April 17, 1922.

[It was obviously impossible to give an account of "genuine scientific work now being carried on in our midst" without occupying a great many more pages than we usually do for our Editorial Notes. In the space at our disposal we could not have done more than use the results of that scientific work to criticise Dr. Berman's book. In this number of DISCOVERY an account is given by a well-known research-worker in certain fields of the study, Dr. L. T. Hogben, of *Some Recent Work on the Ductless Glands*.—ED.]

To the Editor of DISCOVERY

SIR,

I am greatly interested in your proposal to set up a commission to collate the views of Science, Religion, and Intellect on the Problem of Human Personality. If the object is achieved satisfactorily it will not only meet a need urgently felt by most thoughtful people, but it will also, I think, achieve a definite advance in many branches of discovery.

All reasoned thought is an attempt to unify our otherwise disconnected experiences, and it can never be content till it has succeeded in unifying, or collating, every aspect of all our experiences. To my mind this characteristic of the human mind, the attempt to unify all experience, is no mere phase of human evolution, but is the reflection, or expression, of a fundamental reality. My acquaintance with the bulk of the knowledge embraced in these three terms is only of the general, or popular, kind for which DISCOVERY primarily caters; but the apparent differences between their conclusions seem to me to be almost entirely due to, first, the differences between their respective terminologies, and, second, the failure of their votaries in general to recognise that their own terminology is necessarily in part merely metaphorical and in part merely arbitrary; that it is not, and in the nature of things cannot be, an exact and complete expression even of the particular conceptions which it is intended to represent, much less of the fundamental realities which these conceptions attempt to connote. They all, in fact, appear to me to be merely adventures of discovery into the same region, but using different languages, and setting out from different starting-points, or specially devoted to the investigation of different, but quite arbitrarily segregated, portions or qualities of the field of investigation.

Physical organisms have an independent career only to the extent that the life in them succeeds in co-operating with the physical world and so utilising it for the furtherance of its own self-expression. The more completely it succeeds in so co-operating, the higher becomes the form of life. Now, science appears to me to be the reflection, or expression, in our present highly artificial environment of the fundamental need of knowing ever more and more about the physical world in order to be able more and more effectively to co-operate with it for the satisfaction of the insatiable requirements of self-expression—requirements which seem to grow as it were in geometrical progression in proportion to the process of their realisation. Religion is the expression of the impulse to "get there" in self-expression, as distinct from the steps by which we try to get there; while the various mental activities summed up by you under the term *intellect* appear as the reflection of the fundamental need of judging of the degree of adaptability of our physical environment to the requirements of our self-expression, and of seeking perchance some other means of meeting these requirements, means maybe created by ourselves or by our fellow-men. But each of these is intrinsically mixed up with the other, is merely a different aspect of the same thing. The division into these three, or more, groups is itself only an arbitrary, and more or less borrowed, division, the only justification of which is the attempt to unify or simplify our experiences by classifying them; which is just the method of all reasoned knowledge. It is probable that none of the experiences dealt with by one of these groups can exist without the experiences dealt with by the others. For instance, it is probable that the desire to "get there" is only called into activity by contact with the means of getting there. Or it may well be, for instance, that relativity reigns at the very heart of things, that the difference between God's Creation and our own creation is merely one of degree, reflecting a similar difference between God and ourselves, or that the physical world is really merely the expression of that difference.

In any event it is clear that these various branches of discovery are so closely inter-related that each must throw a flood of light on the other; and I, for one, will await with eager interest the result of such an enquiry.

Yours, etc.,
J. R. HALDANE.

29 FRANCIS STREET,
STORNOWAY.
April 24, 1922.

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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Editorial Notes

THERE are many ways of writing about science, but all would be in praise of it, and most would be unnecessary. For it may now be taken for granted that science holds a high position in the minds of thinking men and women, and that it is one of the things that will continue to grow in power and influence. Regarded merely as a matter of interest for leisure hours, the discoveries of science are engaging the attention of a gradually increasing body in the community. But there is an aspect of science which is often emphasised, and yet one to which attention might be often profitably called, and that is its effect on modes of thought, the value of its method in forming opinion.

* * * * *

Science, no doubt, has concerned itself mainly with simple things, the easy problems, but what an achievement is hers! How has she so often successfully reached the bottom of things? By a method, a method which consists in collecting and weighing evidence, organising its facts, and generalising them to a clear conclusion. Science, it has been said, is really an animated logic in which the mind receives its first training among real things—real palpable things—not mere words or abstractions. Its method consequently should help us to be both logical and lucid, to go straight towards the truth instead of wandering around all anyhow. The thesis of these notes is that the scientific method can be and should be applied to all questions that matter a great deal, questions both personal and national which do not appear to be getting solved by the present methods, and which indeed are at a distance from solution which is roughly proportional to the solver's neglect of the scientific method.

* * * * *

The subject is big, and we can say little more about it here beyond drawing attention to its existence. Let us contrast, however, the opinions expressed on scientific matters with those on subjects, more difficult and complex perhaps, but which are yet capable of being investigated by the methods of science. It is not possible for anyone to talk nonsense seriously about scientific matters without quickly being found out, and so for the most part the uninformed man keeps his mouth shut. But, unfortunately, on other subjects, like economics, history, sociology, politics, where the scientific method has got little more than a footing, the expert who knows his subject as well as at present it can be known is worried by all kinds of uninformed people, who speak as with authority out of empty minds. We, the listeners, do not heed the expert, but tend to accept whatever is personally most pleasant to us, without inquiring sufficiently from what evidence or experience the conclusion we accept is derived. Just think, for example, of the kind of evidence, and the kind of people who give it, from which we are asked to form an opinion on, say, the working of prohibition in the United States, or on some political subject. And the tragedy is that many scientific things concerning which we demand a high standard of truth do not matter very much, while the other things do.

* * * * *

Let us consider one of the latter things first. Many writers in the political reviews tell us that war is a "biological necessity," that wars will always be fought, that human nature never changes, and so on. Many people believe this. Let us consider very briefly the first statement: war is a biological necessity. Who say this? It was said and is repeated by those who know little about man, little about his past, little about biology. But the biologists don't say this, and when people are talking about biological necessities they

have a right to be heard. And, indeed, the men who have studied this subject as ably and as completely as human beings can study anything take a different view.[1] They think that biological necessities like over-population and search for food have little to do with causing war. War is, they believe, a custom. They are even inclined to think it a custom of relatively late origin. It is now merely a mode of action whereby an organised state tries to achieve certain political ends. Note the important bearing of this informed view of war on our political conduct. War, a biological necessity, seems an evil we are powerless to resist. But if the biologists are right in thinking there is nothing in the nature of man or of social organisations which renders war inevitable, it is within the power of mankind to renounce war as a mode of action. This illustrates clearly how an unscientific view can lead people in the wrong direction.

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Let us take, secondly, an example from physical science itself. Some months ago there was great ado about a man in Canada who claimed he could bring down rain artificially in a dry district. He had, among other things, a box of chemicals whose contents he kept secret, and he claimed that in some way or other this (the box, not the secret) helped to bring down the rain. Many believed that this method was an excellent one, because rain and clouds often appeared as if in obedience to the magician's box. But none of these observers really sifted the weather statistics of previous years to learn if there was really anything abnormal in this. On the other hand, many people condemned a procedure of this kind as a fraud (or, to use a better-tempered phrase, a "frost"), not because they knew anything about meteorology or this particular application of it, but simply because they did not understand it. They did not understand it, and therefore it was wrong. A second objection to the method was that the rain-producer was paid when he achieved a success, but was not fined correspondingly or, I believe, at all when he failed. This was considered unsporting, and because the rain-producer was not a sportsman it followed at once, these people argued, that the method must be bad.

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It is of course apparent that none of these opinions are of any value in helping towards an ideal—man's ability to produce rain wherever or whenever he wills. But they are typical of the kind of argument which people love to use. The only one whose opinion is of value is the meteorologist who has studied this subject. What does he think? As a matter of interest we may give his views. The meteorologist[2] says two things. First that the scientific scrutiny of results furnishes no real evidence whatever that anything abnormal occurred when the rain-producer was active, and secondly that, as far as he knows, there is only one way of making water vapour in the air condense, and that is by cooling it below its dew-point. This may be done in two ways: by cooling the air directly, which is impracticable because of the cost of cooling, and by raising the moist air high enough and, by so decreasing its pressure, cooling it; but this cannot be done because there is no source of energy available to do it. Other ways have been suggested from time to time, notably a method of agitating the air by firing guns or exploding shells, but these, after consideration, are rejected as not being of value. The meteorologist thinks artificial production of rain impossible at the present time.

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There are two things we should say in conclusion. We do not believe the scientific method is universally applicable; and on those subjects to which it is applied individuals have not, as a rule, the time or the ability to get at the truth themselves by the approved methods. But there are experts, and we must trust them.

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According to a telegram which appeared in *The Times* of April 24th, a remarkable discovery of "mummy caves" more than sixty feet below the ground has been made in the Koster district, 100 miles west of Johannesburg. It was reported that the remains of a tiger had been seen among the mummified animals in the cave. The tiger, however, does not occur in South Africa. The son of a former owner of the cave stated that he partly explored the cave, which is of great extent, in 1912, and in one place high walls were covered with red pictures, which it may be assumed were similar to the bushmen's paintings. A later dispatch states that the caves have been visited by a scientific investigator, who found in the neighbourhood numerous implements and traces of a vanished race. Although the character of the evidence is not more precisely defined, it may be presumed from this statement that the implements were of palæolithic and not of the usual bushman type. Further investigations are to be made of which the results will be awaited with interest.

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Interest in the problem of the antiquity of man has been further stimulated by the discovery last year at Foxhall in East Anglia of implements which have since been accepted by the highest authorities as undoubted evidence for the existence of man in the Tertiary period. This evidence would, therefore, carry back man's existence to a date many thousands of years

[1] See *The Population Problem*. By A. M. Carr-Saunders. (Oxford: Clarendon Press.) P. 305.

[2] *Nature*. November 3, 1921. P. 313.

before that which has hitherto been generally accepted. The relation of the different types of palæolithic implements to the glacial epochs has also been the subject of a number of articles, written from different points of view, which have appeared and are still appearing in *Man*, the monthly journal of the Royal Anthropological Institute. As a result it would appear that the opposing schools of thought are gradually narrowing down their differences to a point at which the issue may be submitted to the practical test of further geological investigation. The subject is to be ventilated further in a joint discussion between the Anthropological and Geological Sections of the British Association when that body meets at Hull in September next.

The Anthropological Section will also discuss at the same meeting various matters relating to anthropology and archæology of the north-east coastal area of England. Among these will be the important question of the occurrence in this country of the early Neolithic culture known as Magelmöse, the character and distribution of early Scandinavian art in the north of England, which will form the subject of a communication from that well-known authority, Mr. W. G. Collingwood, and Professor Allan Mawer, of Liverpool, will deal with the ethnological evidence afforded by the study of the place-names of this area.

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The Rutenberg controversy will have taken many an ex-warrior's memory back to Palestine, and in particular to the valley of the Jordan, whose waters are apparently to be utilised for irrigation and for the generation of electricity. Little over four years ago, when two successive raids were made by British troops across the river and into the hills of Moab, the valley was the scene of some of the intensest fighting in any "side-show" during the war. As is well known, the valley just north of the Dead Sea is 1,200 feet below ocean level, and is the lowest place on the earth's surface. The second raid was carried out in steaming heat, with the thermometer often at 115° in the shade, and amidst swarms of flies, lice, and mosquitoes. It was only a partial success; the Turks had brought up strong reinforcements. The whole valley, of course, came into our possession in the final offensive in the early autumn of the same year. The Jericho side of the river is dry and barren, but the Plain of Moab, which is already roughly irrigated, is a most fertile producer of grain. There is no doubt that the river, whose current through much of the year is turbulent, could be successfully harnessed for the production of electricity. Many of the *flora* and *fauna* of this weird region are unique. A "large scale" expedition of zoologists and botanists to the valley would obtain most important results.

The Progress of Aerial Photography

By Major W. T. Blake

Aerial photography first came into prominence during the war, when its value at once became apparent. For some little time considerable difficulty was experienced in obtaining a suitable camera, and still more in the production of a long focal lens of large aperture.

Generally speaking, once aerial photography had been developed, it was found that the camera would record many objects which were frequently not observed by the pilot or observer. Photographs were usually taken with the camera pointing vertically

Fig. 1.—Ypres from the air (February 1917) showing the cathedral and cloth hall in the centre of the picture.

A unique photograph, never before published.

downwards either through an aperture in the floor of the aeroplane or strapped to the side of the fuselage. It was usual for the pilot to fly on a level keel at an altitude decided previously, whilst the observer took the photographs as desired. It was generally found best to fly up-wind whilst making the exposure in order that the ground speed of the aeroplane might be as little as possible, though it was found that when taking photographs at a great altitude an extremely fast exposure was not necessary.

Photographs were taken either singly of specific objects, or in the form of an overlapping series covering a long line of country. These photographs were then printed and joined up in one continuous strip, showing, for example, a sector of the enemy's trenches. When it was desired to photograph any given area, one or more machines flew over this area on certain predetermined lines, each taking a series of strip photographs. These were afterwards fitted together in a

FIG. 2.—A MOSAIC OF ALEXANDRIA, CONSISTING OF 174 PHOTOS.

mosaic, and the whole was then rephotographed and distributed to the various commanders. After the war this method was employed experimentally for town-planning purposes and for exploration work, where it has been proved of the greatest possible use.

The British camera most generally used is constructed by Messrs. Williamson Brothers, the size of the plate being 5 × 4 in. The cameras are of a fixed focus type with long focus lenses. Panchromatic plates are invariably used in order that correct colour rendering may be secured. Shutters are of the focal plane type working directly in front of the plate. Several efforts have been made to produce a type of camera which will automatically expose a plate and change it at definite intervals, so that the pilot will have little to do except fly the machine, whilst other attempts have been made to produce town plans by means of kinematography.

Apart from military requirements, the civil uses of the aerial camera will be in town-planning and in

carrying out survey work in countries where natural conditions make ground survey difficult, if not impossible.

One of the most interesting cases in which aerial photography has been used was in the dispute some little while ago between the municipal authorities of Edinburgh and Leith with regard to the boundary between these two places. When affairs had reached a high legal state, it was found necessary to obtain a map of the boundary as no up-to-date map was available. In order to secure the requisite information in the shortest time and with the least expense, an aeroplane was sent up and in the course of one flight secured a series of photographs which were enlarged and pieced together, showing clearly the whole of the disputed area.

After the Armistice all the big towns in Egypt were accurately surveyed from aircraft. In India, Canada, and the United States aircraft have been used to photograph the timber areas, and from the shading, the type of timber which grows in these areas. For medical purposes aerial photography has been employed in order to locate mosquito-breeding swamps.

One of the latest applications of aerial photography has been in Venezuela, where aircraft have been employed to take photographs in the Orinoco Delta in order that the ground might be surveyed for oil-bearing districts. This country is practically impossible to negotiate on foot, but it was found that aircraft could make use of the waterways and photograph the surrounding country, the oil-bearing areas showing up clearly as bare regions in the surrounding vegetation, for oil kills all trees and shrubs in its neighbourhood.

At the present time one of the greatest needs for aerial navigators is the production of suitable and reliable air maps. Such maps must be accurate and should show the ground to be flown over in such a manner that it should be easily recognisable by the pilot of a machine. Existing maps are, in many cases, quite useless, and it is probable that the best form of map will be that prepared entirely from aerial photographs of the routes flown over. These will need certain points emphasising in order that the pilot may compare the ground and map with as little difficulty as possible, but, generally speaking, the aerial photograph will be sufficient in itself to prove a reliable guide for travellers in aircraft.

FIG. 3.—THE GREAT PYRAMIDS TAKEN FROM AN AEROPLANE
The wireless station on the top of Cheops's Pyramid is seen at the bottom of the picture

One particular application of aerial photography, which will be of tremendous use to all pilots, is the provision of aerial photographs of all aerodromes on the international airways. It frequently happens that a plan, even on a comparatively large scale, does not give the pilot the information he desires, and particularly when landing by night on a strange aerodrome he is in great difficulties owing to his lack of knowledge of the landing area itself and the surrounding buildings and obstacles. An aerial map, possibly composed of only one photograph, will show him all details he requires in an instant, and he will experience little difficulty, even in darkness, in selecting a suitable spot at which to glide into the landing ground. The Air Ministry now issues periodically very detailed particulars of all aerodromes known to be in use throughout Europe, and frequently issues plans with the descriptions, but in no single case have aerial photographs been circulated, though in many cases these are available for inspection at the Air Ministry. The "Pilot Book" of civil airmen of the future will undoubtedly contain these photographs, together with other particulars which may be necessary.

During the war one somewhat peculiar use was found for aerial photography, which use may be of assistance to civil pilots when flying in bad weather. It was noticed that different areas had very distinctive types of country when seen from the air. Thus, certain parts of Flanders had the fields arranged, in the majority of cases, in the form of very regular rectangles. Farther south the fields altered somewhat in shape. In other parts, as in England, they were irregular and generally hedged or bounded by trees. Still other parts of the country were thickly wooded; others were mountainous. In all cases this distinctive character was found to extend over certain definite areas. Photographs of typical country were therefore taken and supplied to units, together with sections of the map showing the areas over which each type of country extended; notes were also supplied giving the "colour schemes" of the land. Pilots were then taught to memorise the geographical positions of the various types of country, so that if they were lost through flying for long periods above the clouds or in misty weather, they could gain some idea of their position when they saw the ground again by noting its characteristics. This idea might well be adopted for civil pilots, though under present conditions, when flying on the airways only takes place in fairly good weather, there is little possibility of a pilot losing himself. In the future this method may become of more use, particularly when many private owners use the airways, in addition to the regular pilots who fly only along certain routes.

The Biology of Coral Reefs

By F. A. Potts, M.A.

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THE coral reefs of the tropics are the most characteristic assemblages of sessile animals in the world. They grow in such shallow and clear water that many a traveller is able to bring back an enduring impression of the beauty of these water gardens from some faraway harbour. And for a trained biologist the field offered for observation and experiment is without equal.

A Pacific coral reef, like that represented in the accompanying photograph (Fig. 1), gives the same idea of luxuriant life as a tropical forest. It is hard to realise that the corals which compose it are animals, and that they subsist entirely on animal food. Their peculiar physiological habit of excessive lime secretion, combined with their powers of vegetative reproduction, has enabled them to build, in the course of countless generations, these vast platforms throughout the tropic seas. In each colony there exists a living film, over the massive skeleton of carbonate of lime, composed of innumerable individuals, resembling, in the structure of their soft parts, tiny sea-anemones.

The variations in form of the skeletons of coral colonies are exceedingly striking and beautiful, and parallel every extravagant form of which plant life is capable. Not only do genera and species differ markedly, but within species the variability is so great that their determination is a matter of the greatest difficulty. How far the form of coral colonies is a reflection of the action of external forces such as the wash of the sea and the light of the sun is a problem which has engaged the attention of several biologists of late years. Particularly, since the foundation in 1904 of the Department of Marine Biology of the Carnegie Institution, intended to concern itself with the investigation of tropical seas, this and other problems of coral reefs have been attacked with vigour.

The fastidious nature of reef corals is a commonplace of zoological and geological textbooks. For vigorous growth the water must not be too deep, and they will not grow at all below 25 fathoms. The temperature must be uniformly high; the average for the coldest month of the year must not be below 22° C. They can only grow in the clearest ocean water, containing abundant supplies of small animal "plankton." If the water is at times considerably agitated, then the strongest and most rapid growth occurs.

Within these limits there is, however, a good deal of variation, and on a coral reef widely differing

environments are met with. At the edge of a reef which fronts the ocean the best growth conditions are attained. It may be supposed that the fresh ocean water brings rich supplies of animal plankton, which the coral polyps here are the first to sample and, as the water sweeps shoreward, it is robbed of a good share of the food it carries. A quantitative estimate of plankton over the various parts of the reef has not, however, been made.

Whatever the effect of the agitation of the water on the rate of growth, it certainly results in characteristic modifications of coral form. In the picture already alluded to the colonies of *Acropora* (= *Madrepora*) are shown with their spreading mushroom-shaped base and closely set stumpy branches, hugging the reef surface tightly and offering as little chance as possible to the disruptive force of the Pacific rollers. Many colonies die, but their form is preserved by an enamel-like coat of encrusting *Lithothamnion*—a calcareous plant. (Such colonies appear in the photographs as white patches.) This will grow, however exposed the position ; and on coral pinnacles, where no corals live on the summit amongst the breaking waves, the hardy plant thrives. The edge of Indo-Pacific reefs commonly rises 18 inches or so above the rest of the reef on account of the vigorous growth, and is dry at spring tides. It is called the *Lithothamnion* ridge and is absent from the West Indian reefs.

On the seaward edge below the rim the mechanical effect of the waves is felt less and less, and 6 feet or so below, growth is luxuriant and unrestrained, the *Acroporas*, of a different species, putting out such slender and graceful, or spreading branches, as are generally associated with their growth. This, too, is the effect always to be traced passing shoreward over the reef flat. The *Lithothamnion* ridge acts as a breakwater and protects the inshore corals from the full brunt of the waves. It also ponds back the seawater at low tide, so that on a fringing reef a gigantic shore pool extends between the reef edge and the sandy beach, of uniform depth, in which the numberless coral colonies flourish—resembling a series of low bushes with their tops reaching a uniform level of about 18 inches.

Photograph by A. G. Mayor.

FIG. 1.—EDGE OF CORAL REEF IN PAGO PAGO HARBOUR, SAMOA.

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Mayor has made exact determinations of the abundance and distribution of the various species of corals by tracing a line across the reef from shore to edge and surveying squares of 50 feet along it. In each square the number of heads of coral was counted and classified according to species. A survey of this kind made at Murray Island on the Great Barrier Reef brought out many interesting points. It showed, for instance, that the greatest number of coral heads (belonging to eighteen species) was found about 200 feet behind the *Lithothamnion* ridge and about 1,400 feet from the shore, while the greatest number of species occurred on the ridge itself, though the number of colonies is smaller, many being broken off in time of storm. In the middle region of the reef, where growth is easy in the calm water and nutritive conditions good, there is a struggle between the various species for mastery, and one, *Seriatopora hystrix*, emerges as an undoubted victor, crowding out a number of others. Its zone of dominance is restricted, however, and elsewhere it never occurs. Toward the shore colonies become fewer and fewer with many gaps between, and it is found by experiment that they belong to the hardy species, which will stand exposure to overheating of the shallow water by the sun and suspended mud or sand from the adjacent shore. These, like some species of *Porites*, are very different, in this respect, from the more delicate corals of the middle region and reef edge. Some genera are distributed widely over the breadth of the reef, and in this case there are several species replacing each other, or, as in the genus *Pocillopora*, one very variable species. The photograph here given (Fig. 2) illustrates a colony with massive branches from the reef edge, and a looser delicately branching one from the quieter waters toward the shore, but both belonging to this species. Even more interesting than the correspondence to position is the effect produced in *Pocillopora* by a small crab (*Hapalocarcinus*) which associates itself with the coral particularly. The female, which attains the size of a pea, settles down between two growing buds and controls their growth by the current of water she sends out from her gill chambers. The two buds broaden

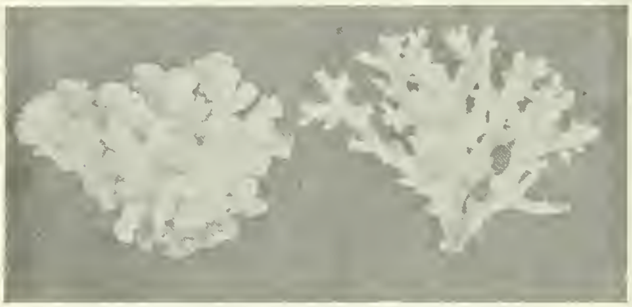

FIG. 2.—*POCILLOPORA* GROWTH VARIETIES.

out to short palmate branches, quite unlike the ordinary slender forms, and curve over and unite to form a closed chamber about the size of a hazelnut, with small perforations serving for the passage of water and food, and kept from closing only by the prisoner's respiratory activity. The female crab is fertilised by the much smaller male before the "gall" closes, and sends out her numerous offspring through the pores. But, though the form of these curious structures reminds one strongly of vegetable "galls," yet there is no exact parallel between the two cases, for the crab works by directing the growth of the coral rather than stimulating the tissues to abnormal activity.

Experimental work on the growth of coral colonies has been conducted by Mayor for some years. The simplest of these are estimations of rates of growth. These are made firstly by taking a colony, photographing and weighing it, putting it on a cement base and attaching a numbered label. The colony is then replaced on the reef and, after a year or eighteen months, if a hurricane has not meanwhile removed all traces of the experiment, it is retrieved, photographed, and weighed again. Such experiments show a considerable rate of growth and confirm the statement made by Stanley Gardiner that in the Indo-Pacific region a reef 150 feet thick might be built in 1,000 years. But the growth rates obtained in the West Indies and the Pacific by the Carnegie Institution differ greatly. It may be said, in fact, that growth is roughly twice as rapid in the latter as in the former, but an explanation of this is yet to be made.

Another line of experiment is the transplantation of coral colonies from one kind of position to another, say from the reef edge to the quiet waters of a channel 20 feet below the surface. Some species, as one would expect, respond to such a change. After a few months it will be seen that their stumpy branches have put out slender shoots, and a remarkable difference may be noticed between the earlier and later parts of the colony, as if a different species had been grafted on the original stock. But in other species the response is limited or entirely absent.

Many observers have recorded the influence of the heavy rainstorms of the tropics on coral reefs. Such a one in May 1920 in Samoa, when 28 inches fell in thirty-six hours, washed down such loads of soil from the island hills into the harbour of Pago Pago that the water changed from dark blue to chocolate, and when it began to clear a thin film of mud coated over most of the coral heads and caused their death. Mud or silt has a selective effect. The brain corals (*Porites*, etc.) are as a rule able to resist its suffocating effects where *Acropora* and *Pocillopora* will perish. But in the case mentioned, huge brain corals, probably fifty years old, were killed and whole stretches of reef

devastated. Such exceptional instances explain the occurrence in the Pacific of reefs whose broad surface is strewn only with dead corals, with a few colonies beginning to work in again from the edge.

There is, apart from this, a marked difference to be traced between the oceanic shores of an island and those within a harbour or estuary where muddy invasions may be usually expected in the wet season. In the latter position the beautiful *Acroporas* and the encrusting *Lithothamnion* are entirely absent. The massive brain corals and the flabby Alcyonarian corals (related to our "Dead Men's Fingers") are the dominant forms of such impoverished reefs, and these corals are provided with an efficient mechanism to get rid of the suspended mud which threatens to choke them.

Many interesting cases of distribution according to environment are to be found among the general invertebrate fauna of a coral reef. The wave-pounded edge would seem to offer a singularly ineligible shelter for any lodger, and yet characteristic forms are found there. The sea-urchin, *Heterocentrotus*, is widespread in the tropics, and a familiar but puzzling form in collections. Seen in its natural habitat, the meaning of its huge mace-like spines becomes apparent. They are pushed into tiny hollows and fissures of the coral blocks, and with the aid of the sucking "tube feet" are quite adequate to maintain the sea-urchin in position against a heavy wave and its backwash. Of

Photograph by W. H. Longley.
FIG. 3.—SCHOOL OF PORK FISHES, MASSIVE CORAL AND SEA-URCHINS (*CENTRECHINUS*), PORTUGAS.

entirely different appearance is the equally characteristic long-spined urchin, *Centrechinus*, which is found only at moderate depths or in the quiet pools of the reef (Fig. 3). The variations in the form of the spines of urchins can be thus roughly compared with those of the corals themselves.

Of the active population of a coral reef, the fishes are without doubt the most interesting. Even the

Photograph by W. H. Longley.
FIG. 4.—SCHOOL OF *NEOMÆNIS GRISEUS*, PORTUGAS.

least thoughtful and speculative traveller is always excited to admiration by them, and indeed they seem such creatures of romance that it is shameful to subject them and their doings to scientific analysis. But coral reef fishes form a biological complex of the greatest interest. The credit of much careful pioneer work in the West Indies and the Pacific is due to Professor Longley, of Baltimore. He has gathered together a mass of information concerning their habits, their coloration and patterns, their conspicuousness against natural backgrounds, their food and many other matters.

A permanent record of many of these points has been secured by his remarkable underwater photographs, examples of which are shown amongst the illustrations to this article. A diving-hood worn over the shoulders and leaving the hands free to manage a camera enables Longley to work under water in the shallow reef channels for hours at a time. He is able to move about slowly to the limit of the 100 feet of rubber piping which connect him with the boat. Though a diver cuts a strange figure according to our terrestrial ideas, he does not seem so strikingly out of place in a submarine landscape. The fishes, which will fly from the shadow of the boat overhead, yet show little or no fear of this uncouth monster groping his way along, and do not suspend their pressing business for him.

The camera used for these photographs is a 5 × 4 inch "Autograflex" enclosed in a watertight metal container. It is a bulky object to carry and takes immense patience to manœuvre into position for an exposure, even when the fish are complacent "sitters."

Various screws and plungers serve the means of adjusting the shutter, focusing, and making the exposures. At a depth of 15–20 feet the light is often good enough to take a snapshot. The photograph of fish in motion (Fig. 4) shows what sharpness of definition can be obtained. But the excellence of the results tends to obscure the great difficulty of manipulation and the large series of failures through unavoidable accidents.

Clear though the water is, the almost impalpable floating organisms and particles make it a much denser medium than air and invest the colonies of corals, branching like trees or massive like crags, with an air of unreality. For this reason the background of the photograph rarely appears in focus.

I can only call attention to one or two of the more interesting observations on the habits of reef fishes. They are not a homogeneous population, but can be divided into sharply marked classes, according to their habits, the parts of the reef they frequent and, particularly, according to the periods of their activity. Some are strictly diurnal like the well-known parrot fishes, others confine themselves to the fissures of the reef by day, like the "squirrel fishes," but the rays of a torch cast on the water at night shows the surface boiling with them. The enormous eyes and golden-red colouring of these nocturnal kinds give them a family likeness to deep-sea fish. Then there is a large intermediate class, like the "pork fishes" (*Anisotremus*) of the illustration, which feed actively at night, as shown by an examination of their stomachs. During the day, however, they do not retire within the crevices, but lazily circle round some coral stack, without ever taking food, and only show signs of returning activity at twilight.

How remarkable their colour patterns are, the picture of *Anisotremus* shows. This happens to be a black and white fish, but the majority of the fishes rejoice in gaudy colours—a habit to which the parrot fishes owe their name. Many of them possess the faculty of colour change to a remarkable degree. In Samoa, for instance, Longley estimated that, out of 197 species which he had under examination, there were 56 able to change colour or pattern. This phenomenon may be easily observed in the few aquaria (like New York, Honolulu, or Madras) where tropical fish are housed, but it requires very patient observation in natural surroundings to estimate the value of these changes. In some cases they are, possibly, as Townsend maintains from his observations at the New York Aquarium, the reflection of the varying emotions of the fish. But for the most part, Longley concludes, the changes are associated with the position of the fish against different types of background, and afford the animal protection by rendering it inconspicuous. Tempting though it is to interpret the bold patterns and striking colours as warning signs, quite the contrary is the case, for when seen in natural surroundings they blend with the background.

So much interest has been taken in the past in geological and geographical problems of coral reefs that their biological aspects are in some danger of being neglected. This article is intended to show something of the results which are repaying the research workers for their study in this comparatively new field.

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The Flight from Reality

By F. A. Hampton, M.C., M.B.

It is probably as much to that faculty that we loosely call imagination as to any other that man owes his supremacy in the struggle for existence, for by it he can make a picture of the future out of the experiences of the past and so obtain a kind of fore-knowledge of events which immensely increases his powers of adaptation and the range of his achievements.

But a certain price must be paid for this constructive power of thought with the knowledge that it gives of the possibilities of the future and the manifold and remote consequences of an action, for man may well find something a little daunting in the vision of reality opened up by his far-reaching consciousness and by the exquisite "awareness" with which it endows him. And this very business of adaptation to life is not always an easy matter, more especially in a civilised setting that has changed more rapidly than the nature

of man, who still carries with him an equipment of instincts necessary in a primitive mode of life but often difficult to utilise or satisfy in an environment that civilisation has sometimes made all too equable. A conflict is, therefore, liable to arise between the "pleasure-pain" principle of the primitive child-self that demands the satisfaction of its wishes forthwith and that more adult, civilised and social self that seeks "to adapt the organism to the exigencies of reality, to subordinate the imperious demand for immediate gratification, and to replace this by a more distant but more permanently satisfactory one." [1]

But imagination comes to the rescue, and that faculty, which was evolved, we may suppose, to enable man to cope more effectively with reality, provides him with a ready means of escape from it by constructing a substitute, or a more genial version of reality.

The easiest escape is into the day-dream where the difficulties and handicaps that keep us from realising our desires are abolished and even the laws of time and space hold no sway. Here the effort of adaptation to life is abandoned and the problem solved—for a time—by adapting reality to ourselves.

A little introspection will show that day-dreams are commoner than we might be disposed to admit, and a real and valuable relief to tired or hurt minds, for the day-dream builds itself and is singuarly effortless compared with that process of directed thinking—of thinking in order to act. The day-dream forms, we know, a large part of the mental life of the child, but there are few who leave it entirely behind, and we still build castles in Spain, the romantic country that provides also the "Spanish prisoner" to play upon our eternal day-dream of getting rich quickly.

Generally, our grown-up fantasies are somewhat prosaic; we recast the events of the day as we would have had them happen, or live in a future of personal or professional success. Sometimes these reveries justify themselves practically and "ideas come to us" that had escaped the pursuit of our more active thinking, ideas that were, perhaps, held back because our conscious self found them a little too bold or because the observations and feelings that gave rise to them were individually too faint and elusive to be recognised and formulated into a logical sequence; for man sets too much store by the efficiency of his reasoning powers to accept the end-product—the inspiration or intuition—when he cannot discover the process that led up to it. But if our day-dreams are prosaic, we can purchase something more elaborate from the artist who lives by his imagination (which is not to say that all literature is "dream-pedlary"), and we may realise our desires vicariously in romances of luxury or adventure or love.

[1] Ernest Jones. *Papers on Psycho-Analysis.* 2nd Edition, 3.

It is perhaps significant of a change in our national psychology that tragedy is no longer popular, that a happy ending to the drama is demanded. It seems as though the deep tragic note of the old ballads and folk-songs were no longer bearable and the robust enjoyment of Byronic melancholy or Victorian pathos an impossibility to the general public of to-day.

If the habit of reading were universal, the type of literature most popular might be expected to throw a good deal of light on the psychological needs of a people and the trend of their unconscious desires, but the public that reads imaginative literature is a comparatively small one, and a more ample reflection of these needs and desires may be found to-day in the cinema. Here the spectator is spared the trouble of conjuring up for himself a visual image out of the written words, and he can become, with a minimum of mental effort, a participator in that drama "silent like a dream" that is played out before him; and the drama is of his own choosing, for competition is keen and the producer is assiduous to supply the demand as perfectly as he can.

Naturally enough, the old type of melodrama is still popular, for it is reassuring to believe, even for an hour, that virtue in the end will be rewarded and vice suitably punished, and it may help a little to reconcile a man with the realities of a life in which these dramatic conventions do not seem to hold. If we are tempted to speculate upon the moral (or demoralising) influence of the cinema, it is well to reckon with this aspect of its melodrama in which we can almost see a literal fulfilment, here and now, of the promise of the Beatitudes.

But all film plays are not coloured by the high moral tone of the melodrama, for, on the other hand, we have the glorification of the successful criminal, a theme that has been popular since, to go no farther back, the days of Robin Hood or Dick Turpin. It has been said that every man is potentially a criminal, which is true in a way, since we begin life as pure egoists and our education consists to a great extent of a gradual subjugation of our personal desires to the interests of society, and, however philosophically we accept our citizenship, we still retain a trace of the primitive anarchism of the child. In the person of the criminal-hero the spectator escapes from the reality of his own moral restrictions and, for a brief while, usually with superhuman luck and agility, triumphantly defies society, and having, as it were, worked off his anarchism, is more likely to return with greater patience to his old submission to law and order than be tempted to any grandiose acts of rebellion.

There are certain themes that recur in myths and legends in many parts of the world and are also found in the fantasies and day-dreams of individuals, though,

since they spring from a somewhat deep level of the unconscious mind, they do not readily come to expression. Such a theme is found in the story of the hero, who is brought up in humble surroundings by foster-parents, coming into his rightful inheritance after he is grown up (i.e. Romulus, Siegfried, etc.), and it corresponds to a fantasy frequently found in children, in which the real mother and father are pictured as foster-parents, while imaginary ones, usually far more exalted and indulgent, are imagined to take their place. This fantasy probably arises out of the idealisation of the parents and the flight into day-dream from disillusionment when the child comes to see his parents as ordinary human beings after all.

This day-dream finds its counterpart in many film dramas where the hero turns out to be the heir to titles and fortune, wrongfully or ignorantly kept out of his heritage, and the spectator, living into the part of the hero, finds along the lines of his old day-dreams some compensation for, even in a measure, a fantastic explanation of, his own exclusion from the riches and power that people, no better than himself, possess.

A theme of similar, and perhaps identical origin, is that of the "hero in disguise," and Haroun al Raschid, the mighty Caliph wandering incognito in the streets of Baghdad, is the legendary figure nearest the modern type who appears in popular drama as a man regarded by his fellows as an ordinary or even negligible mortal, but who possesses some semi-magical power, great wealth or influence which he chooses to wield anonymously and in secret until the last act. Such a fantasy, though doubtless it has a deeper origin, may serve as a fantastic explanation of the discrepancy between a man's own opinion of himself and that held by others; such a fantasy when combined with great egoism may exert a sinister influence on the character and may possibly play a part in the psychology of the poisoner who is sometimes discovered to have added to his list of victims with an apparently wanton inadequacy of motive.

It is in this rôle of the hero in disguise that George Borrow frequently drew himself in "Lavengro" and "The Romany Rye," books that were at first projected as autobiography but to which he gave at one time the significant sub-title of "a dream," a description that may perhaps explain some of their wide, but not obviously explicable, popularity. Borrow also illustrates another line of escape from reality, into the past and the exotic, a mode of reaction from the environment to which archæology and history are probably largely indebted.

But there was one way of escape of which Borrow, with all his mal-adjustment to life, could not or did not avail himself, and that was the way of humour, the attitude that throws down a kind of challenge to reality by denying, or rather levelling down, its values. Perhaps the most thorough-going humorist in this way was that fisherman in Stevenson's fable ("The Poor Thing"), "bitter poor and bitter ugly," with his formula "that in my thought one thing is as good as another," on the strength of which he tried to obtain the King's daughter in exchange for an old horse-shoe that he had picked up in the road. The protective value of humour was very evident during the late war, and there was a fine courage in the attempt by combatants exposed to the worst horrors to treat them as a joke, and the attempt was often surprisingly successful. This levelling down of values seemed sometimes even to result in a truer perspective, for the "Hun" and "Boche" of the newspapers and the home front became simple "Fritz" and "Jerry" in the closer acquaintanceship of the front line, since, as one of their own poets has said:

> "Dort wo der Tod am meisten droht,
> Dort ist nicht Hohn und ist nicht Hass."[1]
>
> (*There where the threat of Death is greatest,*
> *There is no room for hate or scorn.*)

This tendency of humour to belittle the values of reality contains, as do all modes of escape, a slightly retrograde trend, for if sufficiently acutely developed it becomes not easily compatible with any very great enthusiasm or even activity, and it is perhaps significant that it does not find its most obvious expression in those younger nations who are at closest grip with reality. This tendency of humour leads up to a complete denial of the intrinsic value of reality either by a philosophy or by an attitude of detachment from the "insubstantial pageant" of the world.

But the flight from reality sometimes carries farther, making a goal of Nirvana, whether imagined as annihilation or as a compromise in "stirless rest." This ideal, at such cross-purpose with life, has been the theme of much beautiful poetry, usually addressed to death, though perhaps more nearly expressed by Walter de la Mare when he says:

> Somewhere there Nothing is; and there lost Man
> Shall win what changeless vague of peace he can."[2]

For, pessimistic though it may seem, it is probably not identical with a wish for death, since, when we come to examine it in the psychology of the individual, we seem to find it expressed as an unconscious wish to go back again to the beginning—

> Before the birth of consciousness
> When all went well—

[1] Anonymous. From an anthology of German war poetry *Der Deutsche Krieg im Deutschen Gedicht.* (Verlag Morawe und Scheffelt, Berlin.)

[2] "The Tryst," by de la Mare. *Poems* 1901–1918, vol. i.

rather than as a desire to make an end of life. So that there is a deep truth in that apparent paradox of Buddha's teaching that the way to Nirvana lies through life and not through death.

It is more especially the thinking type, the "tender-minded" type of William James, who has the inclination and the power thus to escape from reality, but there are indications that at least among the Western races the thinking type is becoming more common. The old symbols of authority and religion are no longer unquestionably accepted, but at the same time no new guiding lines have been found to take their place. There seems to be a general reconsideration of values and a profound disquieting psychological unrest.

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New Light on the Piltdown Skull

By E. N. Fallaize

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EVER since the discovery of fragments of a human cranium and jawbone at Piltdown in Sussex in 1912, a fierce controversy has raged over these interesting remains. So serious has been the division of opinion that in a recent textbook it has been stated that the Piltdown Skull affords evidence neither as to the date nor as to the character of early man in Europe. While it is unnecessary to take up such an extreme position, it has yet been desirable to recognise that many of the statements relating to early man, in so far as they depend upon the evidence from Piltdown, have rested upon a foundation of which the elements were not universally accepted as secure. Recently, however, an important contribution to one aspect of the discussion has done much to resolve these difficulties and, if it falls short of absolute certainty, has at any rate provided a more secure basis for future work.

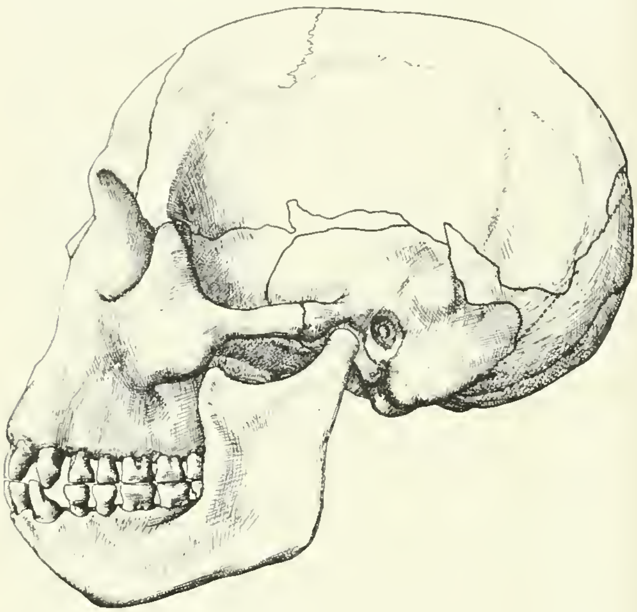
Before proceeding to indicate the nature and bearing of this latest contribution to the subject, it is perhaps desirable to recapitulate briefly the circumstances of the discovery of the Piltdown Skull and the main points of difficulty to which they have given rise. In 1912 the late Mr. C. Dawson found, among gravels which had been excavated by workmen, fragments of a human cranium, part of a lower jaw, a canine tooth from an upper jaw, flint implements of an early and a later type, and a chisel-like implement of fossilised bone of a mammal of elephant type which has not yet been more precisely defined.

In appraising the value of this discovery, the first difficulty encountered was that of the age of these relics of early man. While it was agreed that they were of high antiquity, it was not possible to assign to them with certainty any precise date. The jawbone alone was found in an undisturbed patch of gravel. The remainder were not found *in situ*: some lay as they had been thrown out by the workmen—the skull had been broken up in the course of the work—and others were on gravel heaps some little distance away. It was therefore impossible to say from which strata of the excavation these remains had been derived or whether they all belonged to the same stratum. A number of fragments of the bones of mammals belonging to the Pliocene Age were found. This fact, taken in conjunction with the occurrence of typical specimens of those early types of chipped flints which are regarded by some as man's handiwork, suggested that these were the remains of man of the Pliocene Age, the last phase of the Tertiary Period, and as such represented the earliest human remains found in this country. On the other hand, eoliths, those early so-called implements, afford no criterion of date and are themselves in need of support. Further, it was pointed out, the gravels were river gravels which had been deposited in their present position by running water. Some of the objects exhibited obvious traces of having been water-borne and, it was argued, the association of pliocene remains was probably the result of an early "wash-out." The occurrence of flakes of an early palæolithic type supported a later dating. Accordingly high authorities, such as Professor Sir William Boyd Dawkins, refused to admit an earlier dating than the Pleistocene Age, the earliest period of the Quaternary, immediately preceding the age regarded by geologists as "recent." In taking this view they agreed with Mr. Dawson and Dr. Smith Woodward, the joint-authors of the original account of the discovery.

There for the present the question of dating stands. Failing further evidence, the case of the archæologist for Pliocene man on this site must be held to be not proven. The counter-arguments are strong. Some time after the first discovery, Mr. Dawson found about two miles away two small fragments and a molar of a second skull of similar primitive character; but up to the present, further excavation at Piltdown has produced no fresh evidence in support of either

side. The acceptance of the Foxhall eoliths discovered in East Anglia by Mr. J. Reid Moir would attribute to man in this country an antiquity of possibly one hundred thousand years. It cannot yet be said with certainty that human remains of anything like that age have been found in this country.

In addition there was a second class of difficulties in connection with the human remains. What were the physical characters of the individual to whom they belonged? The evidence consisted of only a few fragments of the cranium and part of a lower jaw. It was not certain, though to be presumed, that they belonged to the same individual. Soon after the discovery, Dr. A. Smith Woodward and Mr. W. L. Pycraft, of the British Museum (Natural History), attempted reconstructions of the skull which confirmed



THE NEW RECONSTRUCTION OF THE PILTDOWN SKULL.

one another in a remarkable degree. From these reconstructions it appeared that the skull was low but of a remarkable breadth, being, in fact, broader than any other known skull; its capacity was low —under 1,300 cubic centimetres, which is considerably below the average of modern man. It was, however, typically human. In the case of the lower jaw there was a difference. Without going into technical details, it may be said that in the absence of chin, the character and disposition of the teeth, and in general conformation, it was distinctly simian, and might have belonged to an extinct form of chimpanzee. So great was the discrepancy that one school, which has received strong support in the United States, boldly declared that the fragments of the cranium and the jawbone were not related, but belonged to two individuals, of which one was human and the other an anthropoid. While this is not impossible, the probability, in view of the circumstances, is against this close association of the remains of man and anthropoid; but the undoubted paradox of the typically human cranium and the simian jaw has proved a serious stumbling block to many anatomists of note. The accuracy of the reconstruction has accordingly been called in question.

Fresh light has been thrown on this question by the remarkable contribution to the subject to which allusion was made at the beginning of this note. A fresh reconstruction of the skull has been made by Professors Elliot Smith and Hunter. Their object was to obtain an endocranial cast, i.e. a cast of the inside of the skull, to form one of a continuous series of endocranial casts ranging from the gorilla to the highest type of modern man, in this case represented by Dean Swift. For their purpose a reconstruction of the skull was necessary, and it was determined to make this reconstruction afresh. To describe the method followed in full would involve great technical detail, which would here be out of place. Briefly, the relation of the fragments one to another was determined by a minute and careful examination of the anatomical points of each and by bringing these into their natural and inevitable disposition. For instance, two of the fragments had retained originally adjacent portions of the natural margins, which, though superficially obliterated in the adult, offer a natural line of fracture in a cranium subjected to violence. In other cases the lines of the sutures indicated the necessary position of the adjacent portion of the skull. As the result of endless experiment, a reconstruction has been built up which was exhibited and described at a recent meeting of the Anatomical Society. It is difficult to speak in terms of moderation of the skill and profound anatomical knowledge which have combined to the making of this reconstruction. The account of the method followed and the detailed description of the result there given carried complete conviction and produced the same effect as the contemplation of a finished work of consummate art.

The new reconstruction generally is confirmatory of the accuracy of the earlier reconstructions of Dr. Smith Woodward and Mr. Pycraft. It is low and broad and of a capacity below 1,300 c.c. It differs, however, in one important respect. The occipital fragment, which determines the shape of the back of the skull, assumes a more vertical position, and this, with the consequent modification produced in the conformation of other parts of the skull, has produced a form which more nearly resembles the anthropoid skull than that of modern man. The result, as Professor Elliot Smith pointed out, is a skull like no other

skull; but its assimilation to the simian skull brings it into complete harmony with the chimpanzee-like jaw. The difficulty which arose from the discrepancy between cranium and jaw has thus been completely and satisfactorily resolved, while the endocranial cast, as might be expected, takes up its place between that of *pithecanthropus erectus*, the fossil skull from Java, and that of the recently discovered Rhodesian Man.[1]

I am indebted to the kindness of Professors Elliot Smith and Hunter for the loan of the drawing of the reconstructed Piltdown skull illustrating this note.

The Fate of a Great Lyric Poet—I[2]

By Edward Liveing, B.A.

The breath whose might I have invoked in song
Descends on me; my spirit's bark is driven,
Far from the shore, far from the trembling throng
Whose sails were never to the tempest given;
The massy earth and spherèd skies are riven!
I am borne darkly, fearfully, afar;
Whilst, burning through the inmost veil of Heaven,
The soul of Adonais, like a star,
Beacons from the abode where the Eternal are.

From Shelley's *Adonais.*

On July 8th, 1822, the greatest, perhaps, of all our lyric poets was drowned in a storm in the Gulf of Spezia off the north-west coast of Italy. The disaster promoted a large number of questions about which considerable discussion took place during the nineteenth century, but which have never been satisfactorily answered. The centenary of the tragedy affords an occasion for retelling the story of Shelley's last days, for drawing attention to some important points in that story, and for a fresh attempt to solve some of those points.

I

By 1822 the remarkable renascence of literature, which has been since named the Romantic Revival, had already reached its zenith, and it is significant that three of its youngest forces were removed almost simultaneously around this date—Keats, in honour of whom Shelley wrote the famous elegy, part of which is quoted at the beginning of this article, at Rome in '21, Shelley in '22, and Byron at Missolonghi, in the cause for Greek independence, in '24.

Shelley and Byron had first met in Switzerland in 1816, and from then onwards the fellow-exiles, though never the closest of friends, had at intervals seen much of one another, notably at Venice and Pisa. In the winter of 1821 we find the Shelleys installed at Pisa in rooms at the top of the Tre Palazzi di Chiesa on the Lung'Arno, opposite the Casa Lanfranchi—the "palazzo" in which Byron, the beautiful Countess Guiccioli, his mistress, and her brother, Count Pietro Gamba, were living. The two households became the nucleus of a young, brave, brilliant and, in general, happy circle. To a flat in the same house as the Shelleys had come Edward Ellerker Williams, a young lieutenant on half-pay, late of the 8th Dragoons, and his pretty musical wife, Jane. Their literary tastes, Jane's charm of manner, and Edward's passion for the sea had endeared them to the Shelleys. The group was next joined by Edward John Trelawny, aged thirty, sailor, buccaneer, adventurer, a man of rugged strength, physically and mentally, of an impulsive yet magnificently loyal and generous nature, sufficient proofs of which will be shown in this narrative alone—altogether a fine product of old Cornish stock. He had arrived "to pass the coming winter in the wildest part of Italy, the Maremma, in the midst of the marshes and malaria, with my friends Roberts [Captain Roberts who was commissioned to build the ill-fated *Ariel*] and Williams; keen sportsmen both—that part of the country being well stocked with woodcocks and wild fowl"; and, "for the exercise of my brain, I proposed passing my summer with Shelley and Byron, boating in the Mediterranean."[3]

Early in February 1822 the circle proposed transplanting itself for the summer to Spezia, over sixty miles farther up the coast. Williams and Shelley found what they considered some suitable houses at Spezia. Meanwhile, before the move was effected, an unfortunate incident occurred on March 24th, the importance of which in relation to the disaster of July 8th has, I think, been overlooked by Shelley's biographers. Late in the afternoon Byron, Shelley, Trelawny, Captain Hay, Count Pietro Gamba, and a certain Taaffe were returning to Pisa on horseback from one of their customary "pistol" parties, when a dragoon, a certain Sergeant-Major Masi, bound apparently on an official errand, rode through them, nearly knocking Taaffe off his horse. What followed is best narrated in the words of Williams,[4] who happened to be in Pisa at the time and to whom Trelawny gave an account of the affair a few hours later:

"Lord B. put spurs to his horse, saying that he should give some account of such insolence. Shelley's horse, however, was the fleetest, and coming up to the dragoon he crossed and stopped him till the party arrived, but

[1] For further reading on this subject see *The Rhodesian Skull and the Antiquity of Man*, by E. N. Fallaize, in the January number of Discovery.

[2] The authorities and materials on which this article is based are numbered in the list of references at the end of the article. In the footnotes the authority is referred to by its number in the list.

[3] Ref. VIII. Pp. 10–11.

[4] Ref. IX. Entry of March 24th.

they had now reached the gate where a guard was stationed, and finding himself so well supported he drew his sword, and after abusing them all as cursed English (*maledetti Inglesi*), began to cut and slash to the right and left, and what signified it to him if he had the blood of all the English robbers—saying he arrested them all. 'Do that if you can,' said Lord B., and dashed through the guard with young Count Gamba, and reached home to bring arms for what he expected would turn to a serious scuffle. The dragoon, finding the rest of the party intended to force their way, made a desperate cut at Shelley, who took off his cap, and warding the blow from the sharp part of the sabre, the hilt struck his head and knocked him down, when Captain Hay parried with a cane he had in his hand, but the sword cut it in two, and struck Captain Hay's face across the nose. A violent scene now took place, and the dragoon tried to get into town and escape, when Lord B. arrived, and half drawing a sword-stick to show that he was armed, the fellow put up his sword and begged of Lord B. to do the same. It was now dark and, after walking a few paces with Lord B., he put his horse into a gallop and endeavoured to get off, but on passing Lord B.'s house, a servant had armed himself with a pitchfork, and speared him as he passed. He fell from his horse and was carried to the hospital. His wound is in the abdomen."

Of Byron's share in the fracas we have his own account,[1] the latter part of which runs as follows: "He called out the guard at the gates to arrest us (we being unarmed); upon which I and another (an Italian) rode through the said guard, but they succeeded in detaining others of the party. I rode to my house and sent my secretary to give an account of the attempted and illegal arrest to the authorities, and then, without dismounting, rode back towards the gates, which are near my present mansion. Half-way I met my man vapouring away and threatening to draw upon me (who had a cane in my hand, and no other arms). I, still believing him an officer, demanded his name and address, and gave him my hand and glove thereupon. A servant of mine thrust in between us (totally without orders), but let him go at my command. He then rode off at full speed; but about forty paces further was stabbed, and very dangerously (so as to be in peril), by some *Callum Beg* or other of my people. . . I need hardly say without my direction or approval. . . . *Who* wounded him, though it was done before thousands of people, they have never been able to ascertain, or prove. . . . They have arrested and examined servants and people of all descriptions, but can make out nothing."

[1] Ref. II. Letter 491. Pisa, May 4th, 1822. To Sir Walter Scott.

For a considerable period after this incident Pisa was in an uproar. Masi eventually recovered. The authorities did not take action against Byron personally or any members of his party, but they imprisoned two of his servants. The citizens appear to have been somewhat divided in their attitude to the "Inglesi." Some openly expressed their admiration of their bravery by doffing their hats to them during the following weeks whenever they saw them riding through the streets. But there is no doubt that a violent undercurrent of feeling against the English colony had been aroused. Medwin,[2] who had himself been at one time a member of the "pistol-club," recorded that, "although the wounded man recovered, his friend vowed vengeance with the dagger not only on Lord Bryon, but on Shelley, and all the English who had formed the cavalcade," and that "Lord Byron was advised by the police to quit Pisa for a time. He complied and took a villa at Montenero, near Leghorn; but after a six weeks' abode there returned to the Casa Lanfranchi."

Masi himself certainly harboured revenge. He was no coward, and he appears to have possessed a strong will of his own. He had fought in several campaigns and received decorations for valour. He refused to take money from Byron, when it was offered to him. On March 26th Williams [3] made this entry in his diary: "It is a singular circumstance that an affair of a similar nature occurred to one of this man's brothers, and, having been cured of a wound which he had received in a scuffle, he waited concealed for the person whom he suspected, stabbed him to the heart and flung him into the river." Further, on April 7th, he notes that the "dragoon is recovering fast, but swears to be revenged when he gets on his legs again."

I have dealt at some length with this incident and the hostility which it produced, because, as I hope to show, its significance cannot be disregarded in the light of later events.

II

On April 15th it transpired that the houses at Spezia which Shelley and Williams had discovered were not to be had at any price. But a house was found on the eastern side of the small bay. The Casa Magni, into which the Shelleys and Williamses moved on April 26th, was perhaps the wildest and strangest of the many strange dwelling-places that the poet inhabited. Mrs. Shelley [4] has left a vivid account of the house (which is still standing), and of its surroundings: "The Bay of Spezia is of considerable extent, and divided by a rocky promontory into a larger and smaller one. The town of Lerici is situated on the eastern point, and in the depth of the smaller bay, which bears the name of

[2] Ref. VI. P. 380. [3] Ref. IX.

[4] Ref. VII. P. 670. Note on poems of 1822.

this town, is the village of San Terenzo. Our house, Casa Magni, was close to this village ; the sea came up to the door, a steep hill sheltered it from behind." The proprietor of the estate, who was insane, had rooted up the olives and planted forest trees on the hillside. " These were mostly young," continues Mrs. Shelley, " but the plantation was more in English taste than I ever elsewhere saw in Italy ; some fine walnut and ilex trees intermingled their dark mossy foliage, and formed groups which still haunt my memory, as then they satiated the eye with a sense of loveliness. The scene was indeed of unimaginable beauty. The blue extent of waters, the almost landlocked bay, the near castle of Lerici shutting it in to the east, and distant Porto Venero to the west ; the varied forms of the precipitous rocks that bound in the beach, over which there was only a winding rugged footpath towards Lerici, and none on the other side ; the tideless sea leaving no sands nor shingle, formed a picture such as one sees in Salvator Rosa's landscapes only. Sometimes the sunshine vanished when the sirocco raged. . . . The gales and squalls that hailed our first arrival surrounded the bay with foam ; the howling wind swept round our exposed house, and the sea roared unremittingly, so that we almost fancied ourselves on board ship." This must certainly have been the case, for the porch and terrace open on to the sea, which frequently penetrates the first floor.

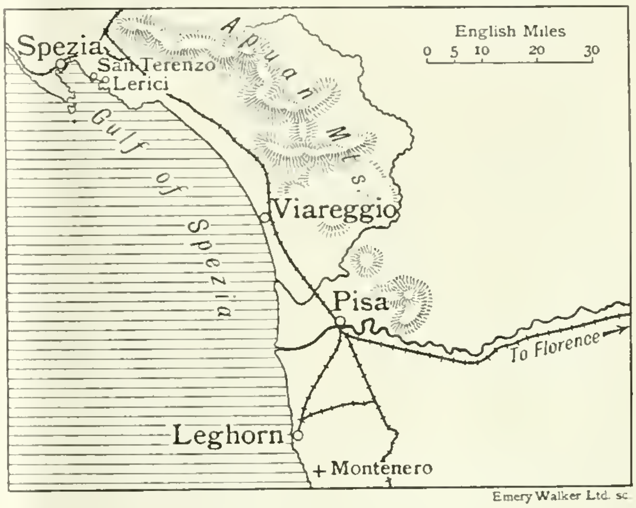
But as the days wore on into summer the heat became intense, and the sea and the cool breezes rising off it were more than welcome. Shelley and Williams spent most of their time on the bay in the *Ariel*. Some while before their departure from Pisa the two friends had commissioned Captain Roberts (already mentioned) to have a boat built for them at Genoa, where Byron was building his yacht, the *Bolivar*. The *Ariel*[1] arrived on May 12th, and the joy with which the ill-fated boat was received may be aptly paralleled to that with which the wooden horse was greeted by the Trojans. She was twenty-eight feet long by eight feet wide, deckless, ketch-rigged, strongly built, and carrying plenty of sail. But she had some dangerous defects, notably the lack of decks. Professor Dowden[2] has pointed out : " The model, obtained from one of the royal dockyards, had been brought by Williams from England, and he had insisted against Trelawny's advice and that of the builder at Genoa, that his model should be closely followed. . . . ' It took,' says Trelawny, ' two tons of iron ballast to bring her down to her bearings, and then she was very crank in a breeze, though not deficient in beam.' "

[1] Byron had had the name *Don Juan*, " in his contemptible vanity," as Williams called it in his journal, painted on the mainsail. The name was eventually cut out of the canvas, and the boat rechristened the *Ariel*.

[2] Ref. IV. P. 549.

III

It was on the *Ariel*, floating over the sultry waters of the Mediterranean, that Shelley wrote most of his last long poem, *The Triumph of Life*. The uncompleted fragment mirrors a restless and uncertain state of mind, and it will not be irrelevant here to consider the psychological change which was beginning to affect the poet, for the questions have often been asked, " Would Shelley, had he lived, have produced greater poetry than even the work of his twenties ? Or was his genius on the wane ? " External circumstances must have played their part in this change. Foremost amongst these was the death of Allegra (Byron's natural daughter by Claire Clairmont), to whom Shelley was devoted, in the Roman Catholic convent of the Romagna ; a growing dislike for Byron on account of the circumstances under which the child had died,



MAP OF THE GULF OF SPEZIA.

and for several other reasons ; the dangerous state of Mary Shelley's health ; a strong attachment to Jane Williams, which he had to check by reason of his loyalty to his wife and his friend.

During the last few months of his life he was constantly troubled by dreams and visions. On May 6th, a few nights after Allegra's death, he was walking on the terrace of Casa Magni, " observing " in company with Williams[3] " the effect of moonshine on the waters," when he became very agitated and " declared that he saw as plainly as he then saw me [Williams], a naked child . . . rise from the sea and clap its hands as in joy smiling at him." Again, on the night of June 22–23 he had a nightmare in which " he dreamt that, lying as he did in bed, Edward and Jane Williams came in to him ; they were in the most horrible condition—their bodies lacerated, their bones starting through their skin, the faces pale yet stained with blood ;

[3] Ref. IX. Entry for May 6th.

they could hardly walk, but Edward was the weakest and Jane was supporting him. Edward said, 'Get up, Shelley; the sea is flooding the house, and it is all coming down.' Shelley got up, he thought, and went to the window that looked on the terrace and the sea, and thought he saw the sea rushing in. Suddenly his vision changed, and he saw the figure of himself strangling me [Mary Shelley], that had made him rush into my room; yet fearful of frightening me he dared not approach the bed, when my jumping out awoke him, or, as he phrased it, caused his vision to vanish." Another vision which he experienced about this time was that of meeting a figure of himself on the terrace of Casa Magni, which said to him, "How long do you mean to be content?" [1]

On June 18th we find the poet writing to Trelawny,[2] who was still at Pisa, "should you meet with any scientific person capable of preparing the *prussic acid, or essential oil of bitter almonds*, I should regard it as a great kindness if you could procure me a small quantity. . . . I need not tell you I have no intention of suicide at present, but I confess it would be a comfort to me to hold in my possession that golden key to the chamber of perpetual rest." There lay something more than a gesture, too, in the poet's suggestion to Jane Williams, who had, one afternoon, entrusted herself and her two babies very rashly to Shelley's handling of a skiff, when they were some way out from land, "Now let us together solve the great mystery." [3]

From early days Shelley had possessed a passionate love for water and the sea. Torrents dash down to mingle their waters in the ocean, storms rage, or silver boats float over placid seas in nearly all of his long poems. References to the sea creep into his most beautiful lyrics—the *Ode to the West Wind*, the ode *To Night*, *The Cloud*, etc. But the poems of 1821 and 1822 show an almost morbid concentration on the sea. Before examining this development further, we must consider the allegorical purport of *The Triumph of Life*, which has been admirably expressed by Professor Dowden.[4]

"The poem," he says, "contains the promise for Shelley's poetry, and perhaps for Shelley's life, of a reconcilement between his pursuit of the ideal and his dealings with actual events and living men and women. The triumphal car of life rolls forward in Shelley's vision amid the mad troop of those who hasten they know not whither; while, bound to the conqueror's chariot, are the world-renowned captives, who, for any lure that life can offer, had yielded up their freedom, or, having fought a vain fight, had been defeated. But all are not there, either in that fierce and obscene crowd or among those melancholy captives. Socrates is not there; nor is Jesus. To know one's self, and to know the Highest, this and this alone makes it impossible that life should ever defeat us or deceive. For, knowing these, we shall know the world, and temper our hearts to its object, loving well, yet wisely, not with the self-abandoning passion of Rousseau, not even with the purer and loftier error of Plato. . . . Henceforth he would be on his guard against the errors of love—against identifying any mortal object with that for which alone man's being is made; he would love what he had found best and truest in life; but even this with a knowledge that it is not the absolute, and with a touch of renouncement in his adhesion."

I think that it must be fairly obvious to anyone acquainted with Shelley's biography and work that his attitude to life during 1821 and 1822 was changing from a destructive, anarchistic one to one that was more human and constructive. He was tending to accept life more philosophically, he was beginning to trust instead of distrust that *élan vital*, as Bergson has called it, that seems to guide the world and the individual. But he was only *beginning* to do this, and the struggle against giving up his old self was very violent and had reached its crisis just about the time of his death. I laid emphasis a short way back on the almost morbid fascination which the sea was beginning to exercise upon him. This was not entirely due to his close proximity to it; a great part of his life had been spent near the sea. Now recent psychological research has revealed the fact that some individuals experience marked changes in personality at certain periods of life. The first changes come, of course, during adolescence; the second usually in the early thirties; and so on. During such a change the individual has, so to speak, to die and to be reborn. Frequent phenomena connected with the change are dreams of putting out to sea, or difficulties experienced in doing so. When the dream occurs in which the individual finally puts out to sea, leaving all the ties of his old self behind him, it is fairly certain that he has at last trusted himself to his new self and to the changed currents of his life. We are here faced with a problem in the case of Shelley which only a trained psychologist could successfully tackle in full detail. Yet here we have a man in his thirtieth year, mentally more mature than his age in certain respects, experiencing dreams in which he is both attracted to the sea and at the same time afraid that it will overwhelm him, and in which he meets the figure of himself, asking him, "How long do you mean to be content?" I do not wish to force conclusions, but for further evidence I would refer the reader to the fragments written in 1821—*A Wanderer*, *Life Rounded with Sleep*, *Great Spirit*—and to the poems of 1822, expressive of an intensifying

[1] Ref. IV. Pp. 560–561, which contain Mary Shelley's account.

[2] Ref. XIII. P. 84.

[3] Ref. VIII. Pp. 90–91.

[4] Ref. IV. Pp. 553–554.

desire to pass beyond the "sandhills of the sea" down to where

> the multitudinous
> Billows murmur at our feet,
> Where the earth and ocean meet,
> And all things seem only one
> In the universal sun.

I believe that Shelley, had he lived, would within a year or so have embraced his new self, embraced humanity, and matured into one of our greatest writers of dramatic poetry, in which direction ample proof of his ability lies in the *Cenci*.

IV

From these conjectures we must return to our narrative. The summer of 1822 was one of the hottest and driest that visited Italy in the nineteenth century. Towards the end of June prayers were being offered up in all churches for rain; at Parma the labourers could only work in the fields before ten o'clock and after five; early in July religious processions wended through the countryside, interceding for rain. On June 19th the Shelleys heard that Leigh Hunt and his family had reached Genoa. He had come out from England to co-operate with Byron and Shelley in producing a new review. With the acrimonious discussion concerning Byron's treatment of Hunt over this review we have no space to deal.

On July 1st Shelley and Williams sailed across the Gulf of Spezia to meet Hunt at Leghorn and to settle him and his family into the ground-floor of Byron's *palazzo* at Pisa. The journey was safely and quickly accomplished, as was its object. But unfortunately the Gambas and Byron had become involved in another fracas at their new villa at Montenero [1] outside Leghorn. For this the Gambas had been banished by the Government from Tuscany, and Byron was considering whether he would follow them into exile. Such a step would entail leaving Leigh Hunt and his projects at Pisa, and Shelley spent most of the subsequent week in attempting to bridge the growing estrangement between the poet and the literary critic. He was largely successful in this, and secured for Hunt's first number the copyright of Byron's *Vision of Judgment*. Hunt and Shelley parted happily on the night of the 7th, at Pisa, the poet taking with him in his post-chaise to Leghorn Hunt's copy of the last volume of Keats' poems, which he was to keep "till he gave it to me with his own hands." [2]

V

The weather on the morning of July 8th was uncertain. It looked as though a thunderstorm was blowing up to put an end to the long period of drought. But the storm passed away, and the intense sun shone once more out of an almost cloudless sky. Something of prophetic irony lies in the fragment written by Shelley a few months earlier:

> When soft winds and sunny skies
> With the green earth harmonize,
> And the young and dewy dawn,
> Bold as an unhunted fawn,
> Up the windless heaven is gone,—
> Laugh—for ambushed in the day,—
> Clouds and whirlwinds watch their prey.

It should be noted here that on the day before Byron had lent Shelley £50. This fact has just been brought to light by the newly-published letters of Byron.[3] This note of hand, as I conclude, was cashed at Messrs. Webb & Barry's, at Leghorn, on the forenoon of the 8th, and is the transaction referred to by Trelawny [4] when he says that "I went with Shelley to his bankers, and then to a store." Webb & Barry were Byron's bankers, and they probably acted for Shelley as well. The £50 "were on board in cash when the boat went down." (Byron's letter already referred to.)

About three o'clock the *Ariel*, with Williams, Shelley, and their young English sailor-lad, Charles Vivian, on board, set sail for San Terenzo. Trelawny had intended to accompany them into the offing on the *Bolivar*, but was prevented from doing this by the officer of the Health Office, as he had not got his port clearance. Instead, he was left behind watching the progress of the *Ariel* through a ship's glass. His Genoese mate remarked to him, "They should have sailed this morning at 3 or 4 a.m. instead of 3 p.m. They are standing too much inshore; the current will set them there." Trelawny replied, "They will soon have the land-breeze."

"'Maybe,' continued the mate, 'she will soon have too much breeze; that gaff topsail is foolish in a boat with no deck and no sailor on board.' Then, pointing to the S.W., 'Look at those black lines and the dirty rags hanging on them out of the sky—they are a warning; look at the smoke on the water; the devil is brewing mischief.'" [5]

Gradually the *Ariel* became enveloped in a sea-fog. The air turned extremely sultry, and Trelawny retired into the cabin and went to sleep. Meanwhile "Captain Roberts had also kept the boat in view. Standing on the end of the mole, he saw her going at about the rate of seven knots. Anxious to know how she would weather the storm which was visibly coming from the Gulf, he got leave to ascend the lighthouse tower, whence he could still discern her about ten miles out at sea, off Via Reggio, and he could perceive that they were taking in the topsail; then the haze of the storm hid them, and he could see them no more." [6]

[1] Ref. V; and Ref. II. Pp. 565–566. [2] Ref. V.

[3] Ref. III. Pp. 228–229. [4] Ref. VIII. Pp. 106.

[5] Ref. VIII. Pp. 106–107. [6] Ref. IV. P. 668.

Trelawny did not reawake till half-past six, and, when he did, it was to the mingled noises of ships shifting their berths, hastily shouted commands, the creaking of anchor chains, and suddenly above everything else the "crashing voice of a thunder squall that burst right over our heads." By then the fate of the *Ariel* had already been sealed.

(*To be concluded in the August number*)

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New Year Decorations in China

By the Rev. C. W. Allan

Visiting China at New Year time, one's attention is attracted by the prevalence of paper symbols and pictures to be seen pasted everywhere on the doors and walls of the houses. A description of some of the more common decorations may not be without interest to our readers.

On the door of almost every house may be seen a single large character, the meaning of which is "happiness." The shape of this character is now familiar to many Western people, being very often used by silversmiths in the making of brooches and buckles. It is a character that is used on every available occasion, to express the paramount wish of the Chinaman—a desire for material blessing. It is the character most commonly recurring in the other mottoes and sentences that are used at this time, pasted in all sorts of positions, and meeting the eye at every turn. Of these, the most common are, "May Happiness descend on us from Heaven," "To Dwell in Peace is Happiness," and "May the Five Blessings come to this House." This last sentence is a favourite one, and the sentiment expressed is a wish for unalloyed pleasure to be extended through life. The "Five Blessings" are Old Age, Wealth, Health, Love of Virtue, and a "Natural Death." The character for a "bat" having the same sound as the one meaning "happiness," it often happens that over doorways are to be seen figures in the plaster moulding of bats flying with outstretched wings, indicating the same sentiments as the written characters.

Another very common expression is to be found written on red paper and pasted up opposite the door of a dwelling. This may be translated, "May wealth spring up before me," an indication of the Chinese desire ever in evidence, to be quickened into life each time the door is passed.

The doors of Chinese houses are generally made with two leaves, which, when closed, have an interstice down the centre of the doorway. On New Year's Eve this is partly covered over with a piece of red paper on which is written, "May good luck attend the opening of the door." In the morning, when the door is opened, the paper, of course, is split.

Over every door are hung five pieces of red paper that have been elaborately cut and shaped by hand during the later days of the old year. These are called "door money." In the twelfth month, any number of men can be seen on the street, with stalls for the sale of pictures and paper, who during the hours of business cut out these lengths of paper with small awls or chisels. There are five in a set, and they are supposed to represent the five blessings mentioned above. There are many styles of these, the best being exceedingly pretty and effective. Not only is the paper cut into designs, but characters and pictures are also pasted upon them. Many have characters in gilt paper with this sentiment: "May I be exalted at an early date."

Perhaps, to the uninitiated, the figures pasted on the doors of Chinese houses are of most interest. These are the "door gods" or guardian deities of the homes. Almost every door possesses a pair of

these energetic and somewhat fierce-looking individuals. These worthies were originally soldiers, who for their services to their country were canonised by a grateful people.

A very popular picture is that of the Chinese unicorn, one of the four fabulous animals of this country. It is depicted as having only one horn and a body covered with scales. For several thousands of years it has not been seen by mortals, except once by Confucius in his old age. . . . It is the symbol of all goodness and benevolence. It is supposed to walk without treading on any living thing, not even on living grass. Its horn is covered with flesh, showing that, though able to fight, it desires peace. Two distinct ideas seem to be present in the popular mind with regard to this animal, and they are expressed in the pictures at New Year time. One idea is that this famous animal brings sons to the deserving, and is, therefore, popular with the women. These pictures, pasted on the doors or other parts of the house, are an expression of desire for such happiness to be granted. They generally represent the unicorn in the act of bringing a small child, whilst behind is seen a boy carrying a banner on which is inscribed the words, "The unicorn brings children," or "The heavenly unicorn gives sons." The second meaning of the unicorn's appearance, also expressed in the pictures, is that the children brought give marks of unusual talent and of future promise as scholars or officials. At the feast of lanterns in the first month, a kind of lantern representing a boy riding a unicorn is sold in great numbers. To buy one of these and present it to a friend is equivalent to saying, "May you have a clever son."

Everyone has heard of the ancestral tablets of China. These are pieces of wood, on which are written the names of the deceased ancestors of families, and which are worshipped periodically as an expression of filial love and respect. There are two kinds used, one containing simply the names of the immediate ancestors, and another on which are written characters that refer also to heaven, earth, the Emperor, parents and teachers. In a well-to-do family the latter tablet especially is an elaborate one, polished and gilded. But in the homes of the common people the tablets are simply slabs of painted wood, with characters inscribed as stated above, and devoid of ornamentation. In the poorest families, however, wood is too dear a thing to buy, and so paper is used. These paper "tablets" are pasted on the walls or boarding of the house, and do duty for the more substantial things of the wealthy. When paper is used, one sheet is sufficient for the two classes of tablets. In the majority of cases, the large characters representing heaven, earth, etc., are written down the centre, and the names of the ancestors by the side. At New Year time, when the houses are cleaned and decorated, it is the proper thing to paste up a new paper "tablet."

Besides the ancestral tablet, there is also to be found in every home a smaller tablet to the god of the kitchen. This deity is supposed to take notice of the actions of every member of the family during the year. During the last month he rises to the presence of the Jewelled Emperor in the skies and acts the part of a recorder of good and evil deeds. The ceremony of sending him on his journey consists of worship with a feast of vegetarian diet, one of the eatables being sugar or sweet soup. Some of this is smeared on the lips of the god, and is supposed either to stick his lips together, or to gratify his taste to such an extent that he cannot or will not tell all he knows about the family.

Perhaps the most popular of Chinese gods is the Ts'ai Shen, or God of Wealth. Every shopkeeper, banker, and merchant has a place in his establishment for an image or some representation of this deity. The most common form is simply a tablet or sheet of paper, on which are written the characters for the "god of wealth." Incense is daily burnt before this deity, and he is supposed to bring wealth to every sincere worshipper. Amongst the pictures sold at New Year are, of course, found those of this popular god.

Another favourite picture is used as a means of driving away evil spirits. The figure is that of an old man who lived in the eleventh century B.C., and who became chief counsellor to Wen Wang, the first Emperor of the Chou Dynasty. He is known as Chiang Tai Kung, or perhaps better still as Chiang Tzu Ya. Wen Wang became acquainted with him in the following manner. One day, when out hunting, he was told by some trick of fortune telling that his quarry would be none of the usual animals but a "Prince's teacher." He fell in with Chiang, then eighty years old, who was fishing with a straight piece of iron, instead of a hook, upon which the fishes allowed themselves to be caught. Wen Wang realised that this man was the one who should be his counsellor, and so took him home in his chariot. He is spoken of by Chinese historians as having authority over unseen spirits. On this account a picture of the old gentleman is often put up above the window or door of a house with this inscription: "His Excellency Chiang is here; of nothing need we be afraid." Where pictures are not available, these or similar words are written on red paper and pasted up.

Some of our readers will be familiar with an octagonal figure composed of small straight lines, in the centre of which are two signs of the appearance of tadpoles

closely interwoven with each other This is known as the *Pa Kua*, or Eight Diagrams. It, also, is used for frightening away evil spirits. These diagrams are said to have been invented two thousand years before the Christian era by the Emperor Fu Hsi, who copied them from the back of the tortoise. Each diagram represents some power in nature, such as fire, water, etc. The centre of the circle is known as the Ying Yang, and is supposed to represent the primeval forces from which all things have been produced. Pieces of board on which are painted these diagrams are often to be found over the doors or on the walls of houses, and are supposed to have a beneficial influence on the household by warding off all evil. At New Year time many of these diagrams are sold, and they are also to be found on the other pictures of gods and men.

The favourite goddess of the women in China is Kuan Yin or, as she is sometimes called, Kuan Shih Yin, the "Goddess of Mercy." She is the deity who is supposed to be always on the lookout for people in circumstances of trouble and suffering, and ever ready to hear the cry of the oppressed. She is specially popular with the women, as she is supposed to respond readily to the appeal for sons which Chinese women always make, as daughters are of little account in that land. In the temples Kuan Yin is sometimes represented as having a thousand arms, each arm being stretched out to succour the unfortunate. Closely allied with Kuan Yin is the figure of the Buddha, which is also a popular one. There are many representations of this deity as he is supposed to appear in different forms.

Amongst the numerous pictures exposed for sale at the New Year, one would naturally expect to find an almanac, seeing the Chinese are so advanced in the study of astronomy and astrology. There are many kinds to be bought, from the elaborately prepared book down to the simple sheet. The almanac holds an important place in China. It is annually prepared at Peking under the direction of a bureau attached to the Board of Rites, and the issue of any counterfeit or pirated edition by others is a penal offence. Of course this only refers to the subject-matter, that is, the settled feast days and days that are auspicious or otherwise. A popular kind of almanac published is known as the "Spring Ox." This has reference to one or more customs prevalent amongst the Chinese, one indeed being confined to the Imperial Court, discontinued since the revolution. This last-mentioned is the ceremony of ploughing by the late Emperors of the Manchu Dynasty in a field adjoining the Temple of Agriculture at Peking. This took place on the day fixed by the astrologers as the beginning of spring. Another custom, also in honour of spring, referred to is that of the prefect of the city with his subordinate officials, accompanied by citizens, going outside the city walls to burn a paper buffalo or ox. This custom varies with the people of different provinces.

There are many more mottoes and pictures to be seen at New Year time than have been mentioned here, but a description of a few of the most popular has been given to manifest a phase of Chinese life about which little has been written. The Chinese are known as a literary nation, but it is not often realised how deeply the cult of the pen in writing and in pictorial art has taken hold of the people of the Celestial Empire.

Reviews of Books

ARCTIC EXPLORATION

The Friendly Arctic. The Story of Five Years in Polar Regions. By V. STEFANSSON. (Macmillan & Co., Ltd., 30*s*.)

In this volume Mr. Stefansson tells the story of the Canadian Arctic Expedition of 1914-1918 which was sent out by the Canadian Government to explore the Beaufort Sea and incidentally to lay claims to any new lands discovered. It was a large expedition with a staff of no less than fifteen scientific specialists beside a number of assistants and natives. A great deal was accomplished, but not so much as Stefansson had hoped, largely because the *Karluk*, his chief ship, with most of the scientific staff, was nipped in the ice and crushed after a long drift. A few new islands were added to the Canadian Arctic Archipelago, and though circumstances prevented a penetration of the Beaufort Sea, it was shown that the existence of land in that region is most improbable. The book is long and full of detail, but never wearisome, for there was much variety and a good deal of adventure, and Stefansson takes his readers into his confidence by discussing all his difficulties as they appeared at the time. The ordinary reader who is not versed in the details of Arctic topograghy may find the greatest appeal in the book in the idea conveyed in the title which challenges the popular conception of Arctic regions. Nine or ten years' experience of this part of the Arctic has convinced Stefansson that it is a very pleasant place where man can live well and easily and suffer no privations or even undue discomfort. He combats the prevailing ideas of hunger, cold, heroic struggles and grim defeat—all this is quite unnecessary. His method of exploration is to live as the Eskimo live by hunting seals on the ice or caribou and musk-oxen on the land, to use blubber for fuel, and to live in snow houses. Even when he started with food on his sledges he was indifferent to the rate at which it was consumed.

When it was finished, hunting provided meals for the future. This method frees the explorer from the necessity of keeping in touch with his base of supplies, ensures light loads and gives him unrestricted liberty of movement. To a great extent Mr. Stefansson has proved the success of these methods, yet lack of seals did force him to retreat to Banks Land in his long march over the ice of the Beaufort Sea, and in another journey two men succumbed in crossing Banks Land alone, possibly, but not with certainty, through starvation. Again, it must not be forgotten that Mr. Stefansson was exploring in a region free from glaciers, with abundant vegetation in summer to support musk-oxen and reindeer. In Banks Land he found a "beautiful country of valleys everywhere gold and white with flowers or green with grass . . . sparkling brooks flowing over gravel bottoms. Heather was most abundant and so were bull caribou." Such a land may well be called friendly compared with the glaciated regions farther east.

The general conception of Arctic travel, indeed of all polar exploration, is undoubtedly erroneous, and dates very largely from the conditions obtaining in the British expeditions during the first three-quarters of the nineteenth century, not to forget the terrible story of the American expedition under Greely. Man-hauled sledges, heavy loads, clumsy fur clothing, intense cold, tinned foods, scurvy, weakness, savage bears, and above all heroic endeavour—these are the stock-in-trade of the story books of polar adventure. Winter was a time to dread, a time of inactivity and depression if not of actual illness. Monotony, largely the outcome of too little to do, had to be fought with such expedients as lantern lectures and magazine production. In reality this sort of thing is largely out of date. The wonder is that it persisted so long, for there is abundant game in most non-glaciated Arctic lands and seals are numerous in the sea. These and birds of any sort make better eating than tinned foods. Dogs are far superior to men for hauling sledges long distances, and experience has shown that the intensest cold need not be feared by men in good condition. Scurvy no longer stalks the polar explorer: he knows well how to avoid it, and the old-time monotony of winter-quarters is easily dispelled by the amount of scientific work that has to be done. Light windproof clothing is a far more effective protection than heavy furs and does not impede free movement. Of course, in Antarctic regions conditions are rather more severe, but Mr. Stefansson is not generalising for all polar travel. He speaks only of the Arctic, although some of his methods are not inapplicable, and have been adopted, in the south. In one respect, however, many polar travellers will disagree with him. The reduction in weight of the sledges involved carrying no tobacco. It was his "custom to require tobacco users to stop it." Some of us would be loth to call the Arctic friendly under these conditions. The idea that Arctic regions are silent is contended by Mr. Stefansson. We agree that the silence may be often broken by the crying of birds, the booming of grinding ice floes, and the whistling of the wind, even if the buzz of mosquitoes and hum of bluebottle flies are restricted to certain areas. But even so, the Arctic has a silence compared with the urban life which most men live. We compare the silence of the Arctic with the noise of civilisation and closely packed human beings, not with the silence of the deserts. Mr. Stefansson will need to concede this point. Lastly, he maintains rightly that the Eskimo are neither to be pitied for their so-called hard lot nor to be considered as having solved all the problems of existence in Arctic lands. The Eskimo told him that certain regions were uninhabited because no game existed, but believing them wrong, he put his theory to the test and found the game he anticipated. As he says, the spirit of adventure is a development of high civilisation: the Eskimo ventures nothing if the risk is great and there is no hope of material gain.

The book has not a dull page from cover to cover and is well illustrated with photographs and maps.

R. N. Rudmose Brown.

THE TEMPLE COINS OF OLYMPIA

The Temple Coins of Olympia. Reprinted from *Nomisma.* VIII, IX, XI. By Charles T. Seltman. With a Foreword by Sir William Ridgeway. (Cambridge: Bowes and Bowes.)

Mr. Seltman has accomplished an admirable piece of research; his results are of no little interest and his work provides a model of sound archæological method.

Whether the earliest Greek coins were minted first by cities or by individual merchants and capitalists is a matter of dispute, but from the sixth century B.C. civic coinages were the rule. Certain great religious centres, however, minted money of their own, no doubt in order to provide for the needs of visitors to a place of pilgrimage. Of such centres Olympia in Elis was second only to Delphi, for here every fourth year the Greek world met to celebrate in common the Olympic Games. Some numismatists had already suggested that the coins called Elean were in reality struck at Olympia, and a cogent argument in favour of this view was the fact that there was strong reason upon stylistic grounds for dating the earliest of such coins before 500 B.C. while the city of Elis did not come into existence before 471 B.C. By a complete survey of the extant Elean coins Mr. Seltman has proved that they were minted at Olympia, and a careful study of the dies employed has enabled him to arrange them in a continuous chronological series of self-contained groups.

A definite date is provided by the coins struck by the people of Pisa, who seized the sanctuary in 365 B.C., and from this fixed point the chronology must be reconstructed backwards and forwards. Mr. Seltman appears to repudiate the generally-accepted view that the alliance of Elis and Argos in 420 B.C. is reflected in the issue of Olympian coins with the head of Hera. He accepts the date, but upon other grounds, viz. that for the Olympic festival of 420 B.C. an increased coinage was necessary because Athens and Sparta had made peace and visitors from Athens and her dependencies, who had been prevented during ten years of war from visiting Olympia, might be expected in large numbers. It does not seem, however,

that the two reasons are mutually exclusive and both may well have been operative.

This Hera series had previously given rise to difficulties in arranging the sequence of Elean coins which Mr. Seltman's work removes. He has shown that they are the product of a second mint belonging to the temple of Hera, which for a century issued coins contemporaneously with those minted at the temple of Zeus. There is therefore no longer any necessity to displace or telescope any part of the continuous series of Zeus coins in order to make room for them.

The illustrations are excellently arranged, and it is not necessary to be a numismatist to appreciate the beauty of the coins represented upon the twelve plates which accompany the text.

W. R. Halliday.

A PRIMITIVE ISLAND RACE

The Andaman Islanders. A Study in Social Anthropology. By A. R. Brown, M.A. (Cambridge University Press, 40*s.*)

This book embodies the results of research work carried out in the Andaman Islands in the years 1906–1908 under the terms of the Anthony Wilkin Studentship in Ethnology of Cambridge University. Previous studies of the Andaman Islanders have been few, consisting of E. H. Man's book *On the Aboriginal Inhabitants of the Andaman Islands* (1882), M. V. Portman's *Notes on the Languages of the South Andaman Group of Tribes* (Calcutta, 1898), and his *History of Our Relations with the Andamanese* (Calcutta, 1899). A general description of the islands was given by Colonel Sir Richard Temple, at one time Chief Commissioner of the Andaman and Nicobar Islands, in the *Census of India* (vol. iii, 1901).

The great value of this new work on the subject lies in the fact that it employs the latest methods of social anthropology in the study of an almost entirely primitive, isolated people. It has indeed rescued a set of primitive ideas, customs, and legends from oblivion, and only just in time, for Western civilisation is already laying its destructive hands upon them from the Penal Settlement at Port Blair. Research of this kind does not merely serve a purpose in adding to our store of knowledge, but in providing psychologists and psycho-analysts with a new key to the "child" mind as reflected in that of savage peoples, who have developed on lines almost entirely untouched by extraneous influences. From this source much elucidation of nervous afflictions brought about by delayed maturity has already been gained.

A glance at the map will show how isolated the Andamans are. They lie out in the Sea of Bengal at an average distance of 350 miles from the Malay Isthmus on the east, and of 700 miles from that of India on the west. "The balance of probability," says the author, "is in favour of the view that the Andamans were peopled, either by sea or by land, from the region of Lower Burma." The Andamanese have been in their present home for a great many centuries, even if they did not reach it during the period of land connections. They belong to the Negrito race, the two other branches of which are the Semang, dwelling in the interior of the Malay Peninsula, and the tribes inhabiting the interior of the Philippine Islands. Both the other branches have come into contact with other races for centuries back, and "the original Negrito culture and language and even perhaps the original physical type have been modified in these two branches of the race."

In the first four chapters a detailed description is given of these Andamanese tribes' social organisation, their ceremonial customs, their religious and magical beliefs, and their myths and legends. Despite close proximity the various tribes have retained much individuality in these respects, as also very distinct differences in their dialects. In Chapters V and VI the author interprets the psychological significance of these customs and legends, showing how closely connected they are with one another. A tribe is divided into so many local groups, each of which has its own village of palm-leaf huts arranged round a common dancing-ground. Communal life is extremely powerful amongst these local groups, and has been kept going by rigorous ceremonial in every detail of life. In this respect the author demonstrates the importance of the strange customs of painting the body with various coloured clays on special occasions, and particularly before or after the taking of certain kinds of food; of dancing; of weeping; and of the very elaborate initiation ceremonies. The latter possess similarities to some of those practised by Central African tribes. During the period of adolescence rigorous abstentions, especially in the matter of food and partaking in social life, are imposed on members of both sexes, and we find, too, amongst the Northern tribes, the phenomenon of the youth, before being admitted to the clan as a man, having to submit to the cutting of horizontal rows on his back and chest, and having to give proof of his virility by remaining silent during these operations.

In the short space at our disposal it has been impossible to do more than touch on the fringe of the information and ideas embodied in Mr. Brown's book. It is excellently illustrated by original photographs, and includes, besides the chapters mentioned, appendices on the technical culture of the Andamanese, and the spelling of Andamanese words.

E. L.

SCIENTIFIC BOOKS

A Criticism of Einstein and his Problem. By W. H. V. Reade, M.A. (Oxford: Blackwell, 4*s.* 6*d.*)

What possessed Mr. Reade, a philosopher and an Oxford don, to write this book we know not. In tackling the relativists, not from the point of view of philosophy, but on their own ground as mathematicians and physicists, he has shown himself a sportsman, but, if he means this work to be taken seriously, he has put himself into a curious position. It must have occurred to Mr. Reade, who is not a profound mathematician, that, if the errors and fallacies he professes to expose really do exist in Einstein's work, they would long ago have been revealed by others. The scientist of to-day is not deficient in critical power, and diffidence in expressing unfavourable opinions of bad work is rare.

Mr. Reade says in effect: "I do not pretend to be a mathematician or a physicist, but I've done my best to understand Einstein's theory, and to me parts of the explanation which that theory involves appear to be nonsense."

We have, of course, no wish to criticise Mr. Reade for reaching this view; our quarrel with him is that he has published it. If Mr. Reade is neither a mathematician nor a physicist, the opinions he may have on this difficult subject, however cogent and logical they may appear to be to himself, are worthless; for the theory of relativity belongs to a domain of advanced mathematical physics, and none but students of that subject possess the necessary knowledge properly to understand it or to question its validity. We, all of us, are so accustomed to talk with authority on matters about which we know little, or less than we might, that a warning to keep off seems an infringement of our liberty. Nevertheless such talk is bad. The inexpert has no right whatever to criticise the expert. If he wishes to do so because of a desire to make a genuine contribution to the matter, or merely because he likes to criticise, he can attain his desire by first getting to know something about it.

The book, we should say, is often extremely amusing, and, on the whole, is best regarded, we think, as a *jeu d'esprit* written not for those who believe in Einstein's theory (for they would detect its fallacies quickly), or for those who do not (for it would simply make their confusion greater), but for Mr. Reade's own friends. But if it be intended seriously, we may say this. The author does not appear to understand the Michelson-Morley experiment; his views on relative velocity are queer; he fails to understand what a physicist means by time as a fourth dimension; his chapter on the unique position of light is almost somnambulistic. We are not going to quote chapter and verse to show up his errors; there are too many errors. Nor are we going to quote any of his preposterous assertions. We feel that the opinion of any fair-minded reader of this work may be best described in the words of a great classical scholar with which we close: Vainer exposition and worse argument than make up the staple of this book it would be difficult to conceive.

A. S. R.

Problems of Modern Science. A Series of Lectures delivered at King's College. Edited by ARTHUR DENDY, D.Sc., F.R.S. (G. G. Harrap and Co., 10*s.* 6*d.*)

This is a splendid book; a series of popular lectures delivered by experts on recent developments in science. Dr. J. W. Nicholson deals with mathematics pure and applied. In particular he emphasises how "useless" development of pure mathematics may suddenly become of practical consequence, occasionally even of great consequence. The perfectly useless Theory of Tensors, for example, developed by Riemann and others years ago has become the backbone of the mathematical work of Einstein's theory. The Quantum Theory is also described in some detail. Mr. J. B. Dale deals with astronomy, the magnitudes, motion and spectra of the stars, and the latest views on stellar evolution. Dr. O. W. Richardson writes on problems of physics, the Quantum Theory, the work of Bohr on the atom, of Sir E. Rutherford on atomic disintegration, and of Aston on isotopes. Dr. Samuel Smiles deals in a general way with the wonder of modern organic chemistry and touches briefly on photo-synthesis. Dr. Arthur Dendy, the editor of the volume, takes stock of the present position of the Biological Sciences, and carefully outlines their subject-matters, and says several wise words on the interdependence of pure and applied science. Dr. Ruggles Gates writes on recent discoveries in palæobotany, ecology, microscopic research and genetics. Dr. Halliburton, writing on physiology, calls attention to the importance of small things, illustrating by describing the work of hormones and vitamins in the body. Dr. Barclay-Smith's chapter on anatomy is one of the best in the book. He describes, among other things, the structure and functions of the bones of our body, and how beautifully and wonderfully they have been made.

A. S. R.

Some Physico-Chemical Themes. By Prof. A. W. STEWART, D.Sc. (Longmans, 21*s.*)

Students of physical chemistry who have read the usual books prescribed them, and have been appalled by the number and complexity of the subjects they are expected to "get up" in their advanced studies, will find this book extremely useful. Dr. Stewart has taken the trouble to go through the larger monographs and delve his way through original papers to express in concise form the gist of some twenty subjects concerning which the ordinary textbooks say but a few words, and those often halting. The subjects described include pseudo-acids, affinity, theories of valency, the theory of indicators, colloids, the Brownian movement, catalysis, the structure of the atom, and the periodic classification. References are given to original papers and bibliographies are appended. The book indeed is more than merely useful, it is good educationally. Dr. Stewart is to be congratulated upon it.

James Stirling. A Sketch of his Life and Works. By CHARLES TWEEDIE, M.A., B.Sc. (Oxford: Clarendon Press, 16*s.*)

A carefully compiled account of the life and work of the distinguished Scots mathematician (1692-1770) whose name is attached to the theorem in Analysis known as Stirling's Theorem. The book includes also the whole of Stirling's known scientific correspondence, most of which is printed for the first time.

A Treatise on the Analysis of Spectra. By W. M. HICKS, Sc.D., F.R.S. (Cambridge University Press, 35*s.*)

Based on an essay with which the author won the Adams prize at Cambridge in 1921. A book at once an introduction to the subject and a work of reference. The important subject of X-ray spectra, however, is not dealt with. Dr. Hicks realises the incompatibility of his own interesting work on the "oun" and recent work on isotopes, and admits that at present they cannot be reconciled.

The Structure of the Atom. By STEPHEN MIALL, B.Sc., LL.D. (Benn Brothers, Ltd., 1s. 6d.)

An interesting, slight, and in the main an accurate, account of recent work on radio-active changes, isotopes, and the structure of the atom, written by the author, a lawyer, for students of chemistry, in "an easy and not too serious a style" free from mathematical formulæ.

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY

The Andaman Islanders. A Study in Social Anthropology. By A. R. BROWN, M.A. (Cambridge University Press, 40s.)

The Evolution of Kinship. An African Study. The Frazer Lecture, 1922. By E. SIDNEY HARTLAND, LL.D., F.S.A. (Oxford: The Clarendon Press, 2s.)

The English Village. The Origin and Decay of its Community. By HAROLD PEAKE, F.S.A. (Benn Bros., Ltd., 15s.)

MISCELLANEOUS

The World-Story of 3,000,000,000 (?) *Years.* By J. REEVES. With a Foreword by Prof. J. Arthur Thomson, M.A., LL.D. (P. S. King & Son, Ltd., 2s. 6d.)

"*Twinline*" *Tales for Language Learners. The Laurel Wreath* (*Der Lorbeerkranz*), by RUDOLF HERZOG; *The Old Guide* (*Le Vieux Guide*), by JEAN RAMEAU; *Drama*, by ANTON TCHEHOV; translated word by word and edited by E. S. Mole. (The Holerth Press, 8*d*. each).

PHILOSOPHY AND PSYCHOLOGY

Philosophical Studies. By G. E. MOORE, Litt.D. (The International Library of Psychology, Philosophy, and Scientific Method: Kegan Paul, Trench, Trübner & Co., Ltd., 15s.)

The Misuse of Mind. By KARIN STEPHEN. With a Prefatory Letter by Henri Bergson. (The International Library of Psychology, Philosophy, and Scientific Method: Kegan Paul, Trench, Trübner & Co., Ltd., 6s. 6d.)

SCIENCE

Sidelights on Relativity. By ALBERT EINSTEIN. (Methuen & Co., 3s. 6d.)

A translation of two lectures of a semi-popular character entitled Ether and the Theory of Relativity, and Geometry and Experience.

Alternating Current Electrical Engineering. By PHILIP KEMP, M.Sc.Tech., M.I.E.E. (Macmillan & Co., 17s.)

Practical Plant Biology. By H. H. DIXON, Sc.D., F.R.S. (Longmans, Green & Co., 6s.)

The Analysis of Non-Ferrous Alloys. By F. IBBOTSON, D.Met., F.I.C., and L. AITCHISON, D.Met., A.I.C. Second Edition. (Longmans, Green & Co., 12s. 6d.)

A new edition of a standard work on this subject.

The Evolution of Continuity. By DAVID RUSSELL, M.D. (George Allen & Unwin, 16s.)

The Population Problem. A Study in Human Evolution. By A. M. CARR-SAUNDERS. (Oxford: Clarendon Press, 21s.)

Electricity. (Science in the Service of Man.) By SYDNEY G. STARLING, A.R.C.Sc., B.Sc. (Longmans, Green & Co., 10s. 6d.)

Metallography. By C. H. DESCH, D.Sc., Ph.D. Third Edition. (Longmans, Green & Co., 16s.)

A new edition of the standard work on metallography by the Head of the Faculty of Metallurgy in the University of Sheffield, embodying the important work on the physical properties of alloys, on corrosion, and on the metallography of iron and steel done since 1913, the date of the last edition.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. LEWKOWITSCH, M.A., F.I.C. Revised by George H. Warburton. Sixth Edition. Vol. II. (Macmillan & Co., 42s.)

The second volume of the new edition of Lewkowitsch's monumental work, dealing with the technology of the natural oils, fats, and waxes with respect to their preparation, refining, and examination for adulteration.

The Mineral Resources of Burma. By N. M. PENZER, M.A., etc. With an Introduction by Colonel O. C. Armstrong, D.S.O. (George Routledge & Sons, Ltd.)

The New Heavens. By G. E. HALE, Director of the Mount Wilson Observatory. (Charles Scribner's Sons, 7s. 6d.)

The Biology of the Sea-shore. By F. W. FLATTELY and C. L. WALTON, M.Sc. With an Introduction by Prof. J. Arthur Thomson, M.A., LL.D. (Sidgwick & Jackson, Ltd., 16s.)

Bibliographie des Séries Trigonométriques. Par MAURICE LECAT. (Chez l'Auteur: Louvain, Avenue des Alliés, 92; Bruxelles, Avenue Bois Cambre, 16.)

Food Values. What they are, and how to calculate them. By MARGARET MCKILLOP, M.A., M.B.E. Second Edition, revised and enlarged. (George Routledge & Sons, Ltd., 3s. 6d.)

An Elementary Textbook of Coal Mining. By ROBERT PEEL. Revised and enlarged by Daniel Burns, M.Inst.M.E. Twentieth Edition. (Blackie & Son, Ltd., 6s.)

The Drought of 1921. By C. E. P. BROOKS, M.Sc., and J. GLASSPOOLE, B.Sc., A.I.C. (Meteorological Office). (Reprinted from the *Quarterly Journal of the Royal Meteorological Society*, vol. xlviii, No. 202, April 1922.)

The A B C of Wireless. A Popular Explanation. By PERCY W. HARRIS. (The Wireless Press, Ltd., 6d.)

Within the Atom. A Popular View of Electrons and Quanta. By JOHN MILLS. (George Routledge & Sons, Ltd., 6s.)

The Tutorial Chemistry. Part II, Metals and Physical Chemistry. By G. H. BAILEY, D.Sc., etc. Edited by William Briggs, LL.D., etc. Twelfth Impression. Fourth Edition. (W. B. Clive: University Tutorial Press, Ltd., 6s. 6d.

Correspondence

LOST ISLANDS OF THE SOUTHERN OCEAN

To the Editor of DISCOVERY

SIR,

May I be allowed to point out one or two slight inaccuracies in Dr. Rudmose Brown's very interesting article "Lost Islands of the Southern Ocean," in your April number?

I am afraid that what Dr. Rudmose Brown calls "the most remarkable part of the story" of Dougherty Island is partly a myth. I had occasion recently to consult the file of the *Otago Daily News*, which is the principal authority for Stannard's report of having sighted it, and I discovered that the statement which has often been made (e.g. in the Admiralty *New Zealand Pilot*) that he saw the Island *twice*, in 1886 and 1890, has no foundation. By his own account he saw it in 1886 only, and the second date has its origin in a mistake committed by one of the other disputants in a controversy over the existence of the island. The error has been rectified in the latest supplement to the *New Zealand Pilot*.

With regard to Norris's "Thompson Island," this has been seen at least once since his time, by Captain Fuller, of the *Francis Allen*, an American sealer, in 1893. Captain Fuller also saw Bouvet Island, and this latter was seen by Captain Williams, of the American sealer *Golden West*, in 1878, who landed upon it, and by Captain Church, of the *Delia Church*, in 1882, so that it was sighted at least three times between Norris's visit in 1825 and its "rediscovery" by the *Valdivia* in 1898.

Ross's failure to find this island in 1843 was not due to commencing his search, as Cook did, too far to the eastward. He started in longitude 2° W. (over 5° westward of the island) and ran along the parallel of latitude 54° 15′ (approximately) as far as longitude 6° 30′ E. In these circumstances, and considering that he hove-to every night so as to prevent his either passing or running ashore on the island in the darkness, it seems at first sight incredible that he did not sight it. Recently, however, on plotting the tracks of the *Erebus* and *Terror* afresh, from their logs, I found that shortly before they would have fallen in with it they were carried to the northward by a slant of wind (Ross says nothing about this in his book) and passed about eighteen miles north of the island, regaining its parallel a few miles farther on.

Incidentally, the fact that Cook began his search too far to the eastward was pointed out at the time by Le Monnier, who based his argument on the discrepancy between the variations observed by Cook and by Bouvet. This was contested by Wales, Cook's astronomer in the *Resolution*. There is a résumé of the controversy in the first volume of Cook's third voyage.

Yours, etc.,
RUPERT T. GOULD,
Lieut.-Commander, R.N. (Ret.), F.R.G.S.

ADMIRALTY, S.W.1,
May 17, 1922.

To the Editor of DISCOVERY

SIR,

The notes contributed by Lieut.-Com. Gould are of considerable interest, and I welcome them as additions to my article. Voyages of sealers are seldom easy to trace. I have met Canadian sealers at the Falkland Islands who had made many discoveries at the South Sandwich group that they never put on record, partly through indifference and partly for fear of attracting rivals. For my statements about Dougherty Island I found sufficient authority in the *New Zealand Pilot*. Now Lieut.-Com. Gould's painstaking researches have shaken my faith a little in the accuracy of Sailing Directions, but at the same time "the most remarkable part of the story," namely the circumstantial account of the visit in 1886, seems still to hold good.

I am quite aware that Ross began his general search for Bouvet Island well to the west of that island, but he reported that, when in longitude 6° E., he stood S. 55° E. in the hope of finding it. Of course he failed, as I pointed out in my article, because he was already east of the longitude of the island. Lieut.-Com. Gould has, no doubt, found the true explanation of how Ross missed Bouvet Island when he was in the correct longitude.

Yours, etc.,
R. N. RUDMOSE BROWN.

THE UNIVERSITY, SHEFFIELD.
May 25, 1922.

TAXATION AND UNEMPLOYMENT

To the Editor of DISCOVERY

SIR,

At least one of your regular readers would welcome the more frequent appearance of articles similar to Professor Knoop's very interesting analysis of the relations between "Taxation and Unemployment." A true understanding of the various aspects of the Economic and Social sciences is becoming more and more necessary if we are to gather satisfactory fruits from the great inventions of the past and present centuries.

In Section III of his article Professor Knoop, while doubting whether a modest reduction in taxation would help to stimulate employment, suggests that it might lead to a sufficient increase in trade to prevent the revenue suffering any actual loss. I think that while assessment to Income Tax remains on the present basis of the three years' average the revenue must suffer—and rather severely—in the first year of the reduction. Although profits might increase with growing trade, the first effects of the improvement could not be felt until the following year. This being so, the Government would be obliged

to budget for a decreased revenue, to meet which three alternatives are suggested.

The first of these, the elimination of debt redemption, has been chosen by the Chancellor of the Exchequer, in order to enable him to reduce the rate of tax. But, as Professor Knoop points out, there has so far been no reduction of debt out of *taxation*, and the proposed relief amounts to meeting liabilities out of capital. There can be little doubt that there will be a deficit to be met.

Increased borrowing, the second suggestion, is agreed to be bad finance and bad economics; and there is just the possibility that the resultant depreciation in our international credit might accentuate the trade depression.

The proposed reductions in expenditure are also apparently inadequate, as well as on the wrong lines; for, however great the need for economy, such essentials as public education and housing should surely be the last to come under the "Axe." This year's estimates include nearly £140,000,000 for the fighting services—three years after the conclusion of the "war to end war." One of the main roads to reduced taxation and revived trade lies clearly in the direction of a real League of Nations which would ensure a long spell of world peace, as hinted in your Editorial Notes for June. Admittedly this remedy suffers from the same defect as the immediate reduction of taxation. Its full effects could not be felt at once. But I can see no reason why the emergence of more friendly relations between the nations should not be reflected almost immediately in the national account by an immediate cessation of some expenditure on armaments.

Other methods of reducing expenditure—such as a levy on capital to redeem war debt, a reduction of the rate of interest on War Loan, and mutual cancellation of international war indebtedness—and of thus rendering reduced taxation a practical proposition, are, perhaps, rather too controversial for discussion here, although I believe they deserve more sympathetic consideration than they receive in most quarters.

Possibly, however, the most effective means of putting the national revenue in a condition to permit of an immediate reduction in the rate of taxation, and one which if properly understood would gain most popular support, would be to endeavour to increase the yield of the taxes by more intensive administration. It is common knowledge that much revenue escapes the Exchequer through the insufficient staffing of the Inland Revenue Department. As a certain sum of money must be found to meet expenditure, it is clear that, where evasion by the few is possible, the many—and in particular the larger firms and companies who are bound to publish balance sheets, and their employees—will have to be taxed at a higher rate than would be the case if all bore their fair share of the burden. Reduction in the facilities for evasion could be attained in two ways: by rendering the penalties for discovered evasion more severe; and by increasing the technical staff. The comparatively small additional expenditure on salaries would almost certainly be amply rewarded by the collection of large amounts of tax. Our taxation system would acquire in practice as well as in theory the attribute of equality of incidence. The psychological effect of this on the honest taxpayer would be important. For many taxpayers meet the collector's demands reluctantly, not so much because they grudge the money to the nation as that they feel that their neighbours are not all paying their fair share.

Yours, etc.,
R. J. C. WEBER.

3 HIGH STREET,
RUISLIP, MIDDLESEX.
June 6, 1922.

NOTES FROM CONTEMPORARIES

NOT so long ago we were hearing a good deal about proposals for the electrification of our railway systems. On this matter an abstract from a paper read before the Institute of Transport by Mr. Roger T. Smith appeared in *The Electrician* of May 19 (6*d*.). Mr. Smith is not by any means sanguine as to the economic possibilities of such an undertaking at present, but he advocates that railway companies and manufacturers should co-operate closely to produce electric traction equipment. Moreover, he gives interesting details of a new machine, called the "Transverter," and designed by Mr. W. E. Highfield and Mr. J. E. Calverley, which should considerably reduce the cost of transmission of electricity by converting alternating to direct currents.

As we go to press, the latest news of the second Mount Everest Expedition is that it has reached a point less than 2,000 feet from the summit. An important feature of the new attempt is the employment of oxygen. "The apparatus," as it is described in the May number of *The Geographical Journal* (2*s*.), "complete with four bottles of oxygen, weighs 32 lb., and it is estimated that each bottle will serve for 100 to 120 minutes' climbing; or we should say, exercise, for Prof. Dreyer stipulates for as generous a supply of oxygen (2·0 to 2·4 litres per minute) in descending as in ascending, and 1 litre per minute while at rest, even while asleep."

Norwegian literature is finding a growing public in Great Britain. Its sturdiness and virility appeal to a kindred feeling towards life. Yet, as M. Linge indicates in an article on Henrik Wergeland in the April number of *Modern Languages* (1*s*. 6*d*.), "Until 1830 Norway had no literature. Denmark was the intellectual centre. All Norwegians with literary pretensions studied in Denmark, and wrote in Danish, according to Danish principles. In that momentous year, 1830, however, the German romantic movement, and the influence of the national reawakening in France, reached Norway. Wergeland was thrilled and produced his great work." This was a poem, *The Creation—Mankind and the Messiah*. It advocated freedom and equality, and greatly matured the campaign for separation from Sweden. The Norwegian Authors' Society has recently proposed that the Government should purchase Wergeland's house in Kristiania and turn it into a Wergeland Museum.

THE Editor regrets that the first part of Mr. Julian S. Huxley's paper on *Sex and its Determination* has been unavoidably held back till the August issue.

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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Edited by EDWARD LIVEING, B.A., Rothersthorpe, Northampton, to whom all Editorial Communications should be addressed. (Dr. A. S. RUSSELL continues to act as Scientific Adviser.)

Published by JOHN MURRAY, 50A Albemarle Street, London, W.1, to whom all Business Communications should be addressed.

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Binding cases for Vol. II, 1921, are now ready. Price 2*s*. 6*d*. net each; postage, 9*d*.

Editorial Notes

THE Hawthornden Prize, given annually "for the best book published during the year by a writer under forty years of age," was presented by Mr. John Masefield to Mr. Edmund Blunden on June 29, for his latest volume of poetry, *The Shepherd*. Many of our readers will remember an article which Mr. Blunden wrote for DISCOVERY a year ago on John Clare, the peasant poet of Northamptonshire; some, no doubt, have read Mr. Blunden's work in *The Waggoner* and *The Shepherd* and been impressed by its full colour and detail, reminiscent of the landscapes of the old Dutch painters, and by an inspiration which seems to spring out of the heart of our English countryside. Indeed the dominant characteristic of this young poet's work is its quality of expressing not only the material appearance of our landscapes, but the hundred and one associations, sensations, emotions which they rouse in individual English hearts. If Mr. Blunden can use his strong feelings for rural beauty as a background before which English men and women play out their lives, he may develop into a very great poet. This remains to be seen.

* * * * *

It has been said that the greatest works of art and literature have never been created out of a cosmopolitan atmosphere, but have been derived from the national environment and sympathies of their creators. But the world is changing fast, and individually and racially we are becoming more cosmopolitan in environment and mind. In these columns we have consistently advocated the fostering of a friendly and peace-loving spirit amongst the nations of the world, but we cannot conceive of an age in which powerful, innate, cherished national characteristics shall have disappeared any more than we can conceive of an age in which all individuals have been reduced to a set standard of mental and physical attainments. The idea is both abhorrent and futile. Attempts at cosmopolitanism in literature have never been attended with much success. In this connection Paul Bourget's novels, with their tendency to present, instead of characters, so many caricatures of nationality, come to one's thoughts; as also the novels of Joseph Conrad, who has attained his triumphs, not really by probing the Oriental mind, but by showing the strangely contrasting characteristics of the white man, with his complex of ideals and materialism unintelligible to the Easterner, against an Oriental background.

* * * * *

There are few countries or nations so individualistic as these islands and their inhabitants. We feel that this is not a statement biased by patriotism. It is a fact which comes home very vividly to any Englishman returning to his country after a long sojourn abroad. Often he is disappointed for a while. The effusive welcomes, friendships, and society to which he has grown accustomed are wanting; the streets are filled with serious faces; there is a coldness of manner about his countrymen which is difficult to understand. But gradually, as he picks up the threads of national life, remakes old friendships and forms new ones, he is conscious of the deep affections and steadfast characters of those around him. He says to himself, "I have felt with my native land, I am one with my kind," and he is rightly proud of his own people and of his birthright which unites him to them. The winter, with its mists and damp cold, gives way to

the deep greens, thick hedgerows, sparkling showers, and drawn-out sunsets of an English summer, which has an incomparable freshness and fragrance. It is not surprising that our literature is imbued with an unusually distinct national spirit; that many of our most beautiful lyric poems, *Summer is i-cumen in*, Milton's *L'Allegro*, Keats' *Ode to Autumn*, could have sprung from no other people or countryside than our own; that our finest narrative poetry from Chaucer's *Canterbury Tales* to Masefield's *Reynard the Fox* teems with the sights, sounds, customs, and individuals peculiar to our country; that the greatness of *Vanity Fair* lies in its unconsciously expressed attitude of the Britisher to life rather even than in the gentle irony with which it attempts to expose that attitude; and the greatness of *Far from the Madding Crowd* in the beauty of the wide spaces of Dorsetshire, which is revealed not so much in direct description as in the conversations and thoughts of the native characters, which have been moulded by them.

* * * * *

With all our superficial differences in character, we share with one another the main instincts and intuitions of humanity, and the man who knows himself is most capable of understanding, and sympathising with, his fellow human beings. This realisation may, perhaps, be applied without stretching a point to literature of a strong national trend. One nation is as much part of the world as one individual is part of a nation. If an individual writer is true to intuitions arising out of racial emotions, he is more likely to be true to the deep underlying emotions of mankind generally than the writer who attempts to be cosmopolitan. The great Greek tragedians are classic examples even to-day of this fact, but no more obvious example could be given than the plays of Shakespeare. As we write these notes the scene of the hero's death in *Antony and Cleopatra* comes vividly to mind.

* * * * *

Holding her dying lover in her arms, Cleopatra, half-mad with grief and a woman's passionate desire to save the object of her love with her caresses, says:

> welcome, welcome! die where thou hast lived:
> Quicken with kissing: had my lips that power,
> Thus would I wear them out.

Antony addresses her as Egypt, and this sudden word sums up the intricacy of the man's attitude to the woman representing the country, the fine and the false ideals, the love of the woman herself, everything, in fact, for which he has lived and is perishing. Then follows a noble passage in which the man, despite his pain, is intent on securing the woman a happy future, and the woman is equally intent on preserving her honour and following her lover to death:

> *Ant.* One word, sweet queen:
> Of Cæsar seek your honour, with your safety. O!
> *Cleo.* They do not go together.
> *Ant.* Gentle, hear me:
> None about Cæsar trust but Proculeius.
> *Cleo.* My resolution and my hands I'll trust;
> None about Cæsar.

When Shakespeare wrote these magnificent lines, he wrote them for an English audience, and he drew a picture, full of the English sense of chivalry, of his ideal Englishman and his selflessness under stress of terrible emotion, of a type which he knew would appeal to other members of his race as well as to himself. And yet, could any scene be truer to the high emotions and aspirations of mankind in all lands and ages?

* * * * *

Last November we drew attention in these notes to the lack of interest amongst our so-called educated classes in the scientific and scholastic achievements of the day. We remarked that the fault lay partly with the public and partly with the research workers. A similar statement must be applied to contemporary literature. In awarding the Hawthornden Prize Mr. Masefield declared that "I am convinced that, if some great wave of encouragement for art comes to these islands, there will come a great wave of artistic effort, which will inspire even the most aged of artists to begin anew." At the present moment there is a lamentable lack of encouragement by the public of good creative writing. The fault lies, perhaps, rather with the changes which are affecting us nationally and individually than with the artist or his public. Whatever the cause, an ever-widening gulf is appearing between those writers who set out merely to appeal to the man who wants an easy piece of sentimental drivel to intoxicate his week-end, and the more brilliant set who, in an endeavour to avoid appearing "popular," have become only dull or neurotically sordid and gruesome. This is, of course, particularly true of the novel, the "best sellers" looking to their public and their pockets, and the better class writing more with their heads than with their hearts, and often attempting to gain an atmosphere of cosmopolitanism. We feel that, if only some authors will come forward with creative work reflecting the true, the average life and characteristics of our people and the beauty of their islands, and yet showing the changes that are taking place in their traditions and social environment, a remarkable renascence in literature may ensue.

Sex and its Determination—I[1]

By J. S. Huxley, M.A.

Fellow of New College, Oxford

Sex appears to be absent in one great group of organisms, the Bacteria. There are also here and there a few species of plants which only reproduce asexually—the banana, for instance, never sets seed; it is therefore clear that sex is not a necessary accompaniment of life. Why, then, is it so widespread?

The answer is given by the well-known facts of Mendelian heredity. Through sexual reproduction, the factors in the chromosomes are at each generation shuffled and recombined in new arrangements; and this provides the possibility of combining separate advantageous mutations in a single stock. If, for instance, a tall pea with green seed-coat is crossed with a dwarf pea with yellow seed-coat, all combinations will occur in the second generation—tall yellow, tall green, dwarf yellow and dwarf green. If tallness and yellow colour happened to be more advantageous than dwarf size and green colour, then it is obvious that any race which possessed both these characters would be well placed in the struggle for existence. If crossing were impossible, such a race could only arise if both the favourable mutations were to occur in one line. To put it in the most general terms, we may say that, if separate mutations arise in a species in a given time, then if sexual reproduction does not exist, the result will be x varieties; but if it does exist, then by recombination 2^x varieties are possible. If the number of mutations had been ten, the number of varieties would be 10 in the one event, 1,024 in the other. The existence of sex thus obviously favours constructive change, and makes it possible for a species, if the conditions in which it finds itself alter, to adapt itself to them much more rapidly.

It has been supposed that sexual fusion of cells was accompanied by some mysterious rejuvenation, without which the race would die out. This, however, is becoming more and more doubtful. For one thing, it has been found possible by special treatment to keep various unicellular animals like the Slipper Animalcule (Paramecium) reproducing by fission for apparently indefinite periods without any sexual process of conjugation occurring, although conjugation is a normal process in their life-history. The evil effects of inbreeding were supposed to proceed from a similar lack of fresh blood, from the absence of that fusion of gametes from different stocks which normally happens in sexual reproduction. Here again we are now able to give a different and more satisfactory explanation. In an ordinary animal or plant, mutations are occurring all the time. Many of these are unfavourable—they represent little accidents to the factors, to the machinery out of and by which a normal organism is built up. But most of such harmful factors are recessive; that is to say, they may be carried by an individual which is also carrying the dominant factor of the same pair, without any effects being produced; this is so, for instance, in the case of tall and dwarf peas, which when crossed give hybrids containing the factors for both tallness and dwarfness, and yet indistinguishable by inspection from their tall parent. In a large cross-bred population, it will be only rarely that individuals containing two of these harmful recessive factors will be segregated out. But if inbreeding is practised, a little calculation will show that it will produce a number of different stocks, each of them pure for the various factors which were present in the original population. As a result, the recessive factors will appear pure in a number of these stocks, and will exert there any harmful effect they may have; and the general average of the population, in vigour, health, size, and fertility, will go down very considerably. But the poor types can now be rejected by the breeders; and the good types which are left are known to be pure and to possess no more harmful recessive factors. Thus, when the good types are now crossed together, a stock is produced which is as good in appearance as the original, and has the further merit of not containing harmful recessive factors and therefore not continually producing a certain proportion of low-grade individuals. Thus the *immediate* effect of inbreeding on a large mixed population is bad; but if it is judiciously practised, it may be the best means of building up a pure healthy stock. That it cannot be always and

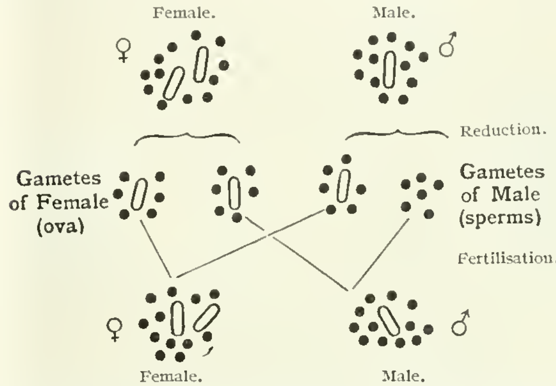

FIG. 1.—DIAGRAM OF THE BEHAVIOUR OF CHROMOSOMES AT REDUCTION AND FERTILISATION IN AN ANIMAL WITH TWO X-CHROMOSOMES IN THE FEMALE, ONE IN THE MALE.

Reproduced from "Mendelism," by Prof. R. G. Punnett, F.R.S., by permission of the Author and of Macmillan & Co., Ltd.

[1] Readers are referred to previous articles on Heredity by the same author in Vol. I, pp. 199 *ff.* and pp. 233 *ff.*, of this journal.—Ed.

inevitably bad is shown by the fact that there exist some animals and a number of plants in which self-fertilisation—the most rigid form of inbreeding possible—is the invariable rule. In brief, it may be said that our understanding of Mendelism has made it clear that inbreeding is only bad when hidden harmful factors exist in the stock, and that it is harmless

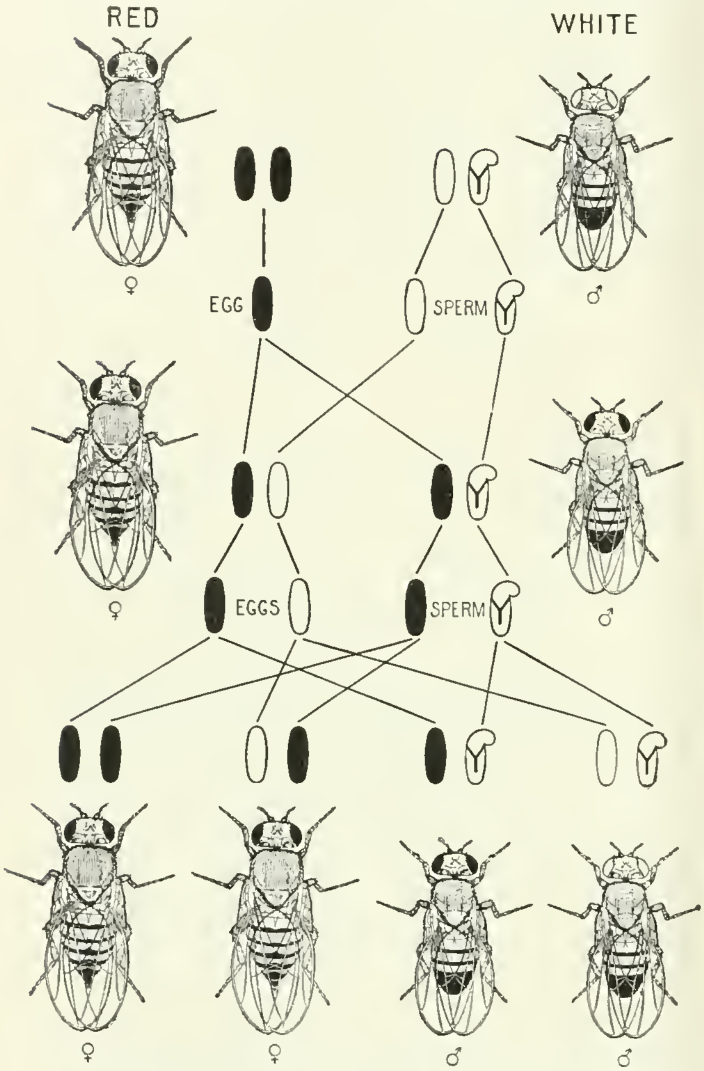

FIG. 2.—SEX-LINKED INHERITANCE OF WHITE EYE IN DROSOPHILA.
Females on left, males on right. The sex-chromosome behaviour is represented diagrammatically; the chromosome bearing the factor for red eye is represented in black, that bearing the factor for white eye in outline.
Reproduced from "Mendelism," by Prof. R. G. Punnett, F.R.S., by permission of the Author and of Macmillan & Co., Ltd.

and even good when the stock's hereditary constitution is a good one. The ecclesiastical prohibition of the marriage of near relatives is thus seen to be only conditionally justified on biological grounds.[1]

[1] The stimulating effect which often follows a cross between markedly different stocks, while also explicable in terms of factors, is due to rather complex causes. The reader is referred to the book by East and Jones.

Two quite distinct processes are involved in the fertilisation of egg by sperm which occurs in the ordinary sexual reproduction of man and most animals. First there is the fusion of two separate nuclei, two single sets of chromosomes, and the consequent shuffling and recombination of the hereditary factors. In the second place, there is what is usually called *activation*—the starting-off of the egg upon its career of growth and development. In most species, if fertilisation does not take place, the egg remains inert, and sooner or later perishes. However, in some animals, such as Aphids (plant-lice) and water-fleas, the egg is capable of developing without this stimulus. Such forms are called parthenogenetic. The bee is of especial interest, since the males, or drones, are fatherless, produced parthenogenetically, while the queens and workers all arise from fertilised eggs. In the course of evolution, a change must have come about so that activation is no longer carried out by the sperm, but by some other means. What in these

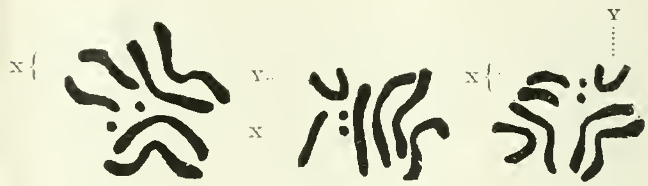

FIG. 3.
Chromosomes (*a*) of normal female Drosophila. (*b*) Of normal male. (*c*) Of an XXY female individual.
Reproduced from "Mendelism," by Prof. R. G. Punnett, F.R.S., by permission of the Author and of Macmillan & Co., Ltd.

animals has happened naturally, has been accomplished artificially for others. In many creatures, such as sea-urchins and starfish, marine worms, molluscs, and even frogs, it has been found possible to make the egg develop without sperm. In sea-urchins the best method is immersion in certain chemicals; in starfish it is heat or shaking; in frogs it is pricking with an extremely fine glass needle which has been dipped in blood. The result is the same—that fatherless individuals are produced by man's intervention. Some of the fatherless frogs have been raised in the ordinary way, and are apparently healthy in every respect. This shows us that the sperm normally performs two functions: it contributes a quota of hereditary factors from the father to the developing embryo; and it activates the egg, probably by chemical means, to start its career of growth and division. This *artificial parthenogenesis* has so far only been tried upon animals which lay their eggs into the water before fertilisation; there can be no doubt, however, that it is theoretically possible in other forms, and that it would be only a matter of surmounting technical difficulties (although

these would doubtless be very grave) to apply it to mammals and to human beings.

The original reason for the wide occurrence of sex is to be sought in the greater plasticity it confers, the greater power of varying in response to changed conditions; but once it was established it reacted markedly upon the later history of life. The gametes are primitively alike; then a division of labour occurs, and the male gamete or sperm takes on the function of finding the female gamete or ovum, which is concerned with storing up food-material for the future development of the embryo; then the individuals which produce the different gametes become different in other ways, that our instincts and the emotions associated with them are the driving force of our actions; that the most primitive instincts, such as those of fear and of sex, are perennially active in us; but that the human mind possesses the power called by psychologists the sublimation of instincts, whereby the instinct becomes directed towards other objects—its driving force harnessed to new, more exalted, and more spiritual ends. So fear becomes the basis of reverence and awe, the sexual instinct gives rise to the highest sympathy, the most universal love.

Sex is thus intertwined, inevitably and fundamentally, with all our activities and with our very being.

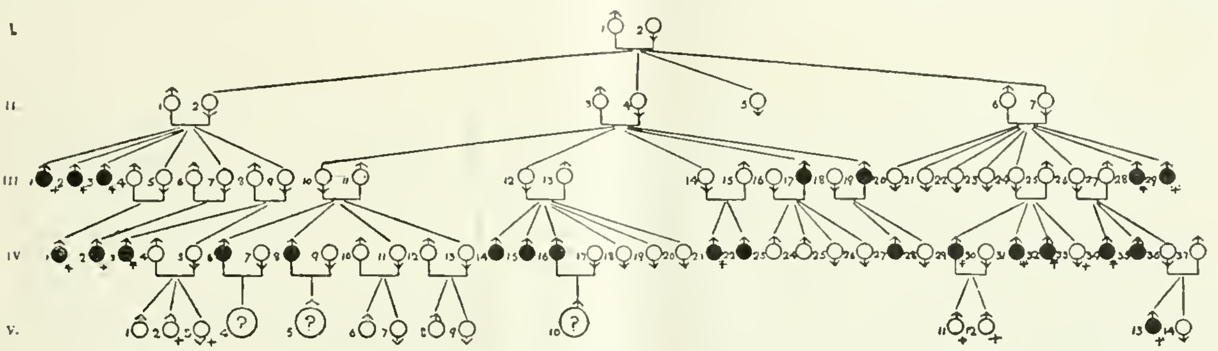

FIG. 4.—PEDIGREE OF A FAMILY IN WHICH HEMOPHILIA OCCURRED; AFFECTED INDIVIDUALS ARE MARKED IN BLACK. ♂ = male, ♀ = female. Note that the affected individuals are all males; that they do not prodnce affected children.

Reproduced from "The Treasury of Human Inheritance," by kind permission of the Director of the Galton Laboratory, University of London.

the male generally more active, the female generally more passive and concerned with the nourishment and care of the young. As mind develops, new complications arise; in the first place, the female requires to be courted and stimulated, her emotions roused, before she will yield to the male; from this cause there have arisen the elaborate and wonderful ceremonies and displays of courting animals, associated often with special colours and structures. Sometimes the result is grotesque, as in the wattles and bare coloured skin of the cock turkey, or the coloured posteriors of many male monkeys; more often the effects are striking, as in the gleaming metallic patches on the legs of many male spiders, displayed to best advantage during their strange courtship dances; or they are of real beauty, like the song of the nightingale or the thrush, the colours of the cock humming-bird, the plumes of the egret, the train of the peacock. It may be indeed said that the sense of beauty has mainly sprung out of the relation of the sexes, and that the actual beauty of animals, where it does not depend simply upon regularity of form, or upon the sense of power or of speed or of vitality produced on us by certain creatures, is due originally to the existence of individuals of separate sexes with emotions which must be touched before sexual union can be consummated. Finally, in man himself, recent work in psychology has shown Man and woman differ from each other, not only in body but in mind; and such is our mental architecture that there are few activities of life in which the sex-instinct, however transformed and sublimated, does not play some part. It thus becomes of the greatest interest to discover the mechanism by which sex is determined, and to find out whether by any means we can bring it under our control.

To do this it is necessary to revert once more to the lower animals. In discussing heredity, we said that the chromosomes of any species were present in pairs, the members of each pair being similar. In a number of species there is an exception to this rule. In certain insects, for instance, while all the chromosomes of the female can be arranged in pairs, those of the male cannot. On closer examination, this is seen to be due to the fact that the male has one less chromosome than the female, and that therefore it only possesses one instead of two of one particular kind of chromosome. This sort of chromosome has been called the X-chromosome. When the female comes to form eggs, ordinary reduction occurs; the two members of each pair separate from each other, and all the eggs receive one X. In the male, however, the X has no mate to pair with; accordingly half the sperms will contain an X, half will be without one. If a sperm with an X fertilises an egg, the result will

be XX—in other words, the constitution characteristic of a female; whereas if the "no-X" sperm fertilises an egg, the result will be X—in other words, a male. As the two sorts of sperm will be produced in equal numbers, an equal number of XX and X embryos will be formed, and this will result in an equal number of adult males and females (Fig. 1).

A similar state of affairs is to be found in many other animals, including cattle, horses, and pigs, and probably in man himself. In other cases, the male, instead of possessing simply an unpaired X, has an unequal pair of chromosomes, one being like the two found in the female, and therefore called X, the other unlike, and called Y. Here again there will be two sorts of sperms; the X-bearing will produce females, the Y-bearing will produce males.

Let us now turn to the results of breeding experiments. Besides ordinary Mendelian inheritance, there has for some time been known another type, known as sex-linked inheritance. An example will make this clear. A mutation producing white instead of red eyes was discovered in the fruit-fly Drosophila. When a white-eyed male is crossed with an ordinary female, all the offspring are red-eyed, showing that white is recessive. In the second generation, there appear 75 per cent. red-eyed animals and 25 per cent. white-eyed, as in a normal case of Mendelian inheritance—but the white-eyed individuals are all males. Still more strange, if the cross is made the other way, between a white-eyed female and a red-eyed male, a quite different result is obtained. In the first generation all the daughters are red-eyed like their father, and all the sons white-eyed like their mother; in the second generation, 50 per cent. are white-eyed, and males and females are equally affected.

The fruit-fly is one of those animals in which the male possesses one X and one Y chromosome. If we suppose that the Y is inactive—a supposition which is, as a matter of fact, borne out by other evidence—this curious and at first sight very puzzling form of inheritance is exactly what we should have to prophesy mathematically, if the factors for redness and whiteness of eye-colour were situated in the X chromosome (Fig. 2). That this view is correct, at least for the fruit-fly, has been definitely shown. Certain stocks of the fly were found which gave exception to ordinary sex-linked inheritance. These exceptions were to be expected if, through some accident to the machinery of cell-division, animals were to have been produced which contained a Y in addition to two X's; and when the stock was examined microscopically, it was actually found that this was the case (Fig. 3).

Exactly similar sex-linked inheritance is found in most other insects, in mammals, and in man himself. For instance, the human diseases known as hemophilia (habitual bleeding due to the inability of the blood to clot) and night-blindness are transmitted in this way (Fig. 4). It is also found in some plants in which the sexes are borne on separate individuals. Since in Drosophila the association of sex-linked factors with X-chromosomes is certain, and in many other animals in which it occurs in the same way, the male also possesses a single X, or an X and a Y chromosome, we may safely say that sex-linked inheritance implies the existence of sex-chromosomes different in the two sexes, and vice versa. It is a curious fact that in birds and in butterflies and moths, while sex-linked inheritance occurs, it is reversed; the female more often shows the sex-linked characters, not the male, and the facts can only be explained if we suppose that in these animals it is the male who possesses two X chromosomes, the female but one. This supposition has been proved to be true in moths, where the microscope reveals that the females have one less chromosome than the males.

(To be concluded in the September number)

The Temples of the Later Stone Age at Malta

By Professor T. Zammit, C.M.G.

Curator of the Valletta Museum

The remains of the megalithic buildings [1] at Hagiar Kim and Mnaidra, not far from the villages of Krendi, Tarxien, Hal-Saflieni, and Cordin, close to the grand harbour of Valletta, as well as the Gigantea in the island of Gozo, are marvellous examples of Neolithic art—the art of the Later Stone Age.

The ruins of the group of temples on the way to Tarxien are of recent discovery, and their excavation has yielded archæological material which throws considerable light on the Neolithic culture of the Mediterranean basin.

The type of these temples corresponds to that of the other Maltese large megalithic buildings which consist of egg-shaped compartments, parallel to each other, and connected by short dolmenic [2] corridors. A wall

[1] The term "megalithic" is applied to these buildings owing to the fact that they are for the most part constructed of huge slabs of stone similar to those of the megalithic monuments—stone arches, standing stones and the like found in various parts of the world and dating from prehistoric times.

[2] These corridors, characteristic of the Maltese Neolithic temples, are called "dolmenic" from their structural resemblance to the dolmen. Dolmens, cell-like structures of two, three, or more slabs of stone standing upright and surmounted by a flat stone or "cap-stone," are of frequent occurrence in Malta.

of megaliths usually surrounds such buildings the entrance of which is found in the middle of a semicircular forecourt. The Tarxien monument consists of three separate buildings raised in succession, though joining each other.

The first temple consisted of two double apses, with a corridor in the middle leading to the north-west to an open space, in which a dolmen stood, probably, against the wall, and to the south-east to an entrance marked by a high threshold. The pillars limiting the corridor are enormous blocks of limestone over 6 feet high, and the apses are made of large hammer-dressed slabs standing erect. The floor is made of a thick layer of a beaten white, clayey earth over a bed of stones. The apses were originally domed over by layers of masonry consisting of hewn stones.

A small window, between two of the wall slabs of the north-eastern apse, looks into a room which probably was the seat of an oracle. It would seem that the Stone Age people consulted oracles and soothsayers very frequently, for similar rooms more or less secluded, with structural features which suggest that they were shut off by a veil, are found in all the Maltese megalithic temples as well as in the Hypogeum, or underground temple, of Hal-Saflieni.

Apparently the earliest temple was found insufficient, for a second was built close to it, so close, in fact, that the western apses of the earlier temple were pulled down to make room for a new wall and for a flight of steps to lead into the new building.

*

This second temple was made larger than the first, for instead of the usual two oval enclosures it has three, parallel to each other, but decreasing in size from south to north. The oval space to the south is the largest, measuring in length about 60 feet, the next about 40 feet, and the following one about 30 feet. Two short dolmenic corridors connect the three oval chambers. The passage between the first and second oval chambers is barred by a slab on end, about 3 feet high, decorated in front by two symmetrical spirals in relief.

This would show that the use of the two northern chambers was restricted to the priests, who entered the holy precincts from a passage to the right of the temple. This passage was reached through a flight of steps wedged in between the walls of the first and second temples. Whilst no sort of decoration appears in the first building, a few carved patterns are met with in the second.

Beside the spirals cut on the slab which obstructs the passage between the first and second compartments, a magnificent scroll pattern is cut on the face of two slabs on end, screening the two apses of the second compartment. The pattern consists of four simple spirals, one at each angle of the slab, with a raised disc in the middle. The spirals, flat and quite smooth, are brought into further relief by a roughened background of circular pittings.

The pitting of stones for decorative purposes is characteristic of the Maltese Stone Age.

FIG. 1.—GENERAL VIEW OF, AND ENTRANCE TO, THE TARXIEN MEGALITHIC TEMPLES, MALTA.

Another remarkable feature of this second temple is a small rectangular room on the walls of which two bulls and a sow are carved in low relief. The walls of this room have suffered a good deal by fire, and the stones are, consequently, cracked and flaky, to the

FIG 2.—SLAB BLOCKING THE PASSAGE TO THE NORTHERN APSES IN THE SECOND TEMPLE AT TARXIEN.

The spirals are simple, and branched off only at one point; they are flat and smooth, thus differing from the spirals of the third temple.

detriment of the carved figures. One of the bulls is badly damaged, but the other one is tolerably well preserved and resembles, in many ways, the animals depicted in the Early Stone Age caves of Dordogne.[1] Below this bull there is a smaller animal, very probably a sow. The outline of this animal is not very clear, but a long row of teats, or very young sucklings, definitely indicate its genus.

In the centre of the two oval chambers, low circular fireplaces are built, which still remain full of ashes; and in a corner of the main entrance a large stone vase, hewn out of a single slab of stone similar to those used in the structure of the building, was found in fragments but has since been repaired.

The third temple is built to the south of the second one, upon one side of which it distinctly encroaches. This fact alone would show that it is a later addition, but one has likewise to note that the plan of the building is inferior in design to the other two, and that there is a great profusion of decoration, nearly every block of stone being ornamented with scrolls in relief.

Three of the rooms of this sanctuary display a charming collection of curved patterns, mostly spirals, simple or branched, single or entwined; some of the patterns are suggestive of thistle leaves, others of goats' horns, whilst on a low step we can see foreshadowed the classical egg-and-tongue ornament.

Four altars in the main hall are carved with graceful scrolls, some of which are in such a low relief as to have the appearance of an inlay broidering the ground. On one of the altars a graceful niche, built of small well-squared slabs, was found standing. The altar under this niche is hollow and has a circular hole at the base deftly plugged by a conical stone of which the surface is so carved as to continue the pattern of the altar face and to disguise the plug.

This cleverly disguised recess was found full of animal bones, the remains of sacrificed animals, mixed with fragments of Neolithic pots; a fine reddish flint sacrificial knife was hidden behind the stone plug.

In this room stood a colossal statue of the deity to whom burnt sacrifices were offered. It is unfortunate that this unique specimen of advanced Neolithic art was not found complete; what remains of it being the legs and a portion of a pleated skirt. It is enough, however, to establish the fact that images were worshipped in the Neolithic Age.

In the same room, in front of one of the altars, a stone vase fixed to the ground must have contained water for ceremonial purification. Close by this vessel there is in the floor a wide circular depression, evidently caused by fire. It was here that a fire was kindled on which the victim, killed by the priest, was roasted or completely burned.

That very choice animals were sacrificed is evident from the masses of bones, mostly charred, that were found in the numerous niches and recesses existing in the building. The bones are of full-sized animals, bulls, goats, sheep, and pigs. Some of the horn-cores of bulls discovered measure over 3 feet in length.

FIG. 3.—NEOLITHIC TYPES OF DECORATED POTTERY, TARXIEN.

Large horn-cores of rams and goats were also found stowed away in closets and niches; all this points to the fact that a portion of the sacrificed animal was deposited as a memento of the offering.

That only certain kinds of animals were used as an offering can be surmised not only from the sacrificial

[1] The most important of these caves from an archæological point of view are situated in the rocks of the valley of the Lower Vézère, Department of Dordogne, South-western France.

remains actually found, but from the representation of such animals carved in two of the rooms of the temple.

The bulls and the pig have already been mentioned; the other animals are carved on two slabs which formed a kind of dado in a side chapel. One of these friezes represents two rows of eleven goats each. The animals, depicted as in motion, are well drawn and carefully modelled; they have long curved horns with a backward sweep characteristic of the Persian wild goat. The other frieze shows four goats, a pig and a ram.

important objects discovered, for they show, as no other object would, the high ideal of human nature entertained in the very dawn of civilisation.

The potsherds collected among the Neolithic material are so numerous as to baffle description. There are fragments of pots of every shape and size, rough and polished, plain and decorated, coarse and thin. The majority of the vases display superior workmanship, being gracefully modelled, with a hand-burnished surface in some cases possessing the appearance of enamel. The colour varies from a light fawn to a

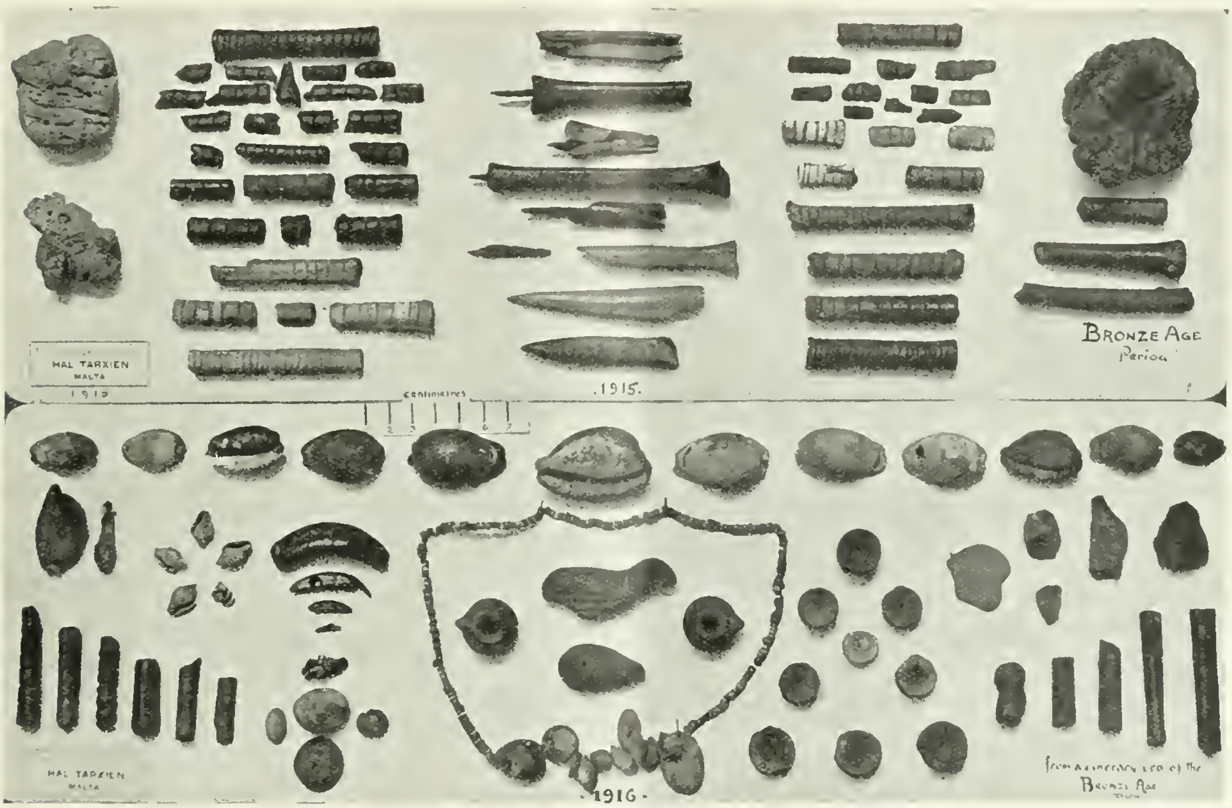

FIG. 4.—BRONZE-AGE OBJECTS FOUND IN CINERARY URNS, HAL TARXIEN.

The foregoing are the main features of the Tarxien temples which have added valuable information to what we already knew about the conditions of life during the Neolithic Age in Malta. The objects discovered in the ruins are hardly less important than the buildings themselves. As one would have expected, stone objects were the more numerous, and included such implements as hammers, mortars, grinders, troughs, and such objects as stone balls, cones of various descriptions, the use of which is not certain, polished stone axes, used probably as amulets, flint and obsidian knives, beads made from marine shells, bone awls, needles, burnishers, etc., all of which were encountered in considerable quantity. Stone statuettes representing human figures are, perhaps, the most

rich brown or a deep black. The plain polished ware is the more common, but decorated pottery was abundant. Fine lines and deep incisions, often filled up with a white or a red paste, decorated the polished surfaces with geometrical patterns; a peculiar black ware is studded with circular bosses, forming sometimes elaborate scroll patterns, which stand out sharply on a white background. Painted ware has also been found, broad bands of a bright red colour being, in these cases, laid thickly along curved lines.

All these objects point to the long experience of an old race which had lived for a considerable period under peaceful and favourable conditions. From information gained from all the Neolithic stations so far excavated, it appears that the Maltese settlers of the

Stone Age were of an average height, slightly long-headed, possessing regular European features without any trace of prognathism—that projection of the lower part of the face characteristic of a negroid type. A hardy seafaring people, they received their civilisation from the neighbouring continents while maintaining the independence characteristic of an island race. They grew proficient in architecture and handled large blocks of stones with great skill, they were a religious people in the sense that they established a cult, sacrificed animals in honour of a deity, and stowed away, in carefully constructed niches, such portions of the burnt offering as they thought most acceptable to the object of their faith.

They buried their dead and practised secondary burials,[1] when pottery, personal ornaments, and polished axes of greenstone, often broken as a ritual ceremony, were deposited with the bones.

Another very important discovery was made during the excavation of the Tarxien ruins. Before reaching the Neolithic material, which was buried in about 3 feet of silt, the excavators came upon an area of about 25 feet square, thickly covered with crushed clay cinerary urns, copper implements, clay pots, and carbonised matter embedding beads, amulets, bone objects, and other personal adornments, bedecking the deceased at the time of cremation. This was evidently a site for the deposition of cinerary urns by a people who practised cremation. These new-comers reached Tarxien when the temples had collapsed for centuries and when 3 feet of silt had accumulated over the ruins. They were in possession of copper tools and weapons, had a pottery unlike any ware ever met with in the Maltese megalithic buildings, and burned their dead, instead of burying them in earth, as was the custom of the Neolithic people.

These remains of a later civilisation which had reached the Island when the Neolithic sanctuary had been buried for a good number of centuries constituted the first piece of evidence to be brought to light which made it possible to establish a date by comparison with similar remains found elsewhere. No Bronze Age settlements had previously been discovered in Malta, while the peculiar conditions of the discovery furnished clear and unmistakable stratigraphical evidence of the time relation of the Bronze and Neolithic cultures.

The metallic implements are of copper and, therefore, the new-comers can be safely dated to about 2000 B.C., the accepted date of the dawn of the Bronze Age in Europe. If it took ten centuries to cover the ruins of Tarxien with 3 feet of silt, this being the accepted rate of deposit in other Mediterranean islands, one can put the height of the Neolithic civilisation in Malta to about 3000 B.C. This date corresponds to the reckoning obtained by comparing the Maltese Neolithic pottery with other known ware such as that of Egypt and of Crete.

The discovery of a Bronze Age settlement at Tarxien, with a full complement of metallic implements and characteristic pottery, is of vital importance when one comes to consider that such implements and such pottery are not met with anywhere else in these islands. Evidently, the new-comers were not numerous, nor did their customs, such as that of burning the dead, prevail over the early habits of the Maltese population.

Want of sufficient intercourse with continental life has at all times compelled islands to develop on their own lines, hence the length of the Neolithic period in this island.

Although it is quite possible that some knowledge of the Bronze Age culture of Egypt had reached Malta, in the course of time, it had very little influence on the Neolithic culture, which continued to be developed on local lines, as evinced by the pottery and by the stonework.

The duration of the Maltese Stone Age culture is still to be determined, but the lesson learned at Tarxien should always be kept in mind by the archæologist who attempts the solution of the problem—viz., that when the small colony, equipped with the tools and the implements of the early Copper Age, reached Tarxien, the people who had built the temples and carved their friezes had been buried for at least a thousand years.

[1] "Secondary burial" is a term applied to the practice, prevalent among some primitive peoples, both ancient and modern, of disinterring the bodies of the dead after the flesh has decayed, and then re-burying the bones or disposing of them in other ways, usually after dismemberment.

THE twentieth International Congress of Americanists meets in Rio de Janeiro this month. The purpose of the Congress, which meets biennially, is to afford an opportunity for the discussion of the problems of the ethnology, archæology, and history of the Americas, and as a rule many valuable papers are contributed to the proceedings. The discussions are held in Spanish, French, and English, and the Congress is attended by scientists from all parts of the world, but in particular from the United States and Spanish America. The American School of Archæology in Mexico, the work of which is not sufficiently well known in this country, usually takes a prominent part in the proceedings. It was during the meeting of the Congress in London in 1912, it will be remembered, that the evidence for the existence of tertiary man in South America was thoroughly thrashed out.

The Congress will sit from August 20–30 under the Presidency of Dr. Lauro-Muller, a distinguished Brazilian.

As Brazil is celebrating the Centenary of her independence, and there will be an International Exhibition at Rio, it is hoped that there will be a large and distinguished attendance. The Congress will be followed by a number of excursions to places of interest.

New Light on Ovid's Story of Philemon and Baucis

By W. M. Calder, M.A.

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One of the best-known stories in classical literature is Ovid's charming tale of Philemon and Baucis. It is the story of an aged couple who dwelt among the hills of Phrygia—as the Roman poets were wont to call the interior of Asia Minor. One day two strangers appeared in the district, and begged for food and shelter. After " a thousand doors " had been closed against them, they were taken in by Philemon and Baucis, who set before them a plain but abundant rustic meal, with a treasured chine of pork to crown the fare. Fearful lest this should not be enough, the aged couple decided to offer the guests their gander, the only living creature they possessed. The bird fled, and took refuge with the strangers, whereupon the latter declared themselves to be Jupiter and Mercury. The neighbourhood, said they, must suffer for its sin of inhospitality, and Philemon and Baucis were directed to accompany the gods up the long slope which led to the mountains. When near the top they turned round, and saw the whole valley flooded, except their own dwelling. While they gazed in wonder, their dwelling changed before their eyes into a temple with marble foundations and gilded roof. They were given a wish, and chose to be priest and priestess in the gods' temple, and, even as they had lived in oneness of heart, to die in one and the same hour. In extreme old age they suffered change into an oak and a lime, which are still shown to the visitor, holy trees, surrounded by a low wall and covered with garlands. The teller of the story vouched for its truth ; he had himself been to the spot, and had hung fresh garlands on the trees, with a prayer.

This story is told in the eighth book of Ovid's *Metamorphoses*. The work is a collection of stories, loosely strung together, the feature common to them being that they all describe transformations of mythical personages into animals, trees, flowers, rocks, and so forth. In common with the *Fasti*, it illustrates Ovid's interest, and the interest of his readers, in what modern writers call the ætiology of ritual—the search for an explanation of the religious practices which they saw around them, or in which they took part. This interest was one effect of the religious revival fostered by Augustus, which has left such a deep impress on the literature and monuments of the period. Just as every city had its sacred foundation-legend, so the explanation of every ritual practice was sought in a story which served as a sort of running commentary on the religious act. The cult was usually traced back to the experiences of some mythical personage ; for example the association of Apollo with the laurel was traced back to his love for a maiden called Daphne (Laurel), who fled from his embrace, and was changed into the tree which bore her name.

Ovid was born in the year of Cicero's death, 43 B.C. Between the age of 40 in 3 B.C., and his exile to Tomi in A.D. 9, he was at work on the *Metamorphoses* and the *Fasti*. When he left Rome, the *Metamorphoses* was apparently complete—at least in a first edition ; the *Fasti* was certainly not. It would be straining the evidence to argue from this that the *Metamorphoses*, in its totality, was the earlier work of the two, but the balance of probability is that the story with which alone we are concerned was composed about the turn of the centuries. It is not necessary for our purpose to fix an exact date ; about 3 B.C. to A.D. 3 is near enough. Ovid must, of course, have been collecting material for the book for some time before he set about its formal composition.

The ætiological myth, or foundation-legend, is a universal feature in ancient Mediterranean religion, and the establishment of a city, temple, or cult had always a religious sanction. The foundation of Rome is told, after their respective manners, by Livy and by Vergil ; by the historian as well as by the poet it is given a religious setting. Greek literature is full of such legends ; the scene which is impressed on the audience before they leave the theatre at the end of Æschylus' *Oresteia* is the foundation of the cult of the Eumenides under the Athenian acropolis ; the *Œdipus Coloneus* of Sophocles is a dramatised version of the weird story which was told to explain the cult of Œdipus at Colonus ; the *Bacchæ* of Euripides turns on the establishment of the worship of Dionysus at Thebes.

Let us look at Ovid's story of Philemon and Baucis from this point of view. It is professedly a foundation-story, and relates how a particular shrine beside a lake in Asia Minor, in which Jupiter and Mercury were worshipped together, came to be established. Such is the essence of the story, as he who runs reads it. But the story is one of a series which was addressed not only to those who were interested in religious origins, but to a fashionable and flippant public. Add that Ovid was the prince of Roman story-tellers, and that all good story-tellers have a habit of touching up and amplifying their material. The student of ancient religion must accordingly use Ovid's stories with caution ; such caution is necessary even in the case of the *Fasti*, which is a more severely technical book than the *Metamorphoses*.

I hope to be able to prove that the story of Philemon

and Baucis is a genuine Anatolian legend, to conduct the reader to the very spot where the legend was originally told, and to indicate the channel through which it reached Ovid in Rome. We shall find that the story contains features derived directly from its Anatolian source. Other features, while germane to Ovid's purpose as a *raconteur*, are without value for the student of ancient religion. Still other features—there are two of them in the story—are of doubtful import. I shall refer to them, but do not found any part of my argument on them.

We may pass over what may be described as mere picturesque detail—the simple, uncomplaining poverty of the old couple, the rustic meal with course after course of country fare, all the details which go to the telling of a good tale—and pass at once to the kernel of religious truth underlying the story. First, there are the sacred trees, covered with garlands, and (do not miss this detail) surrounded by a low wall. How is the sacredness of the trees to be accounted for? For the Anatolian peasant, ancient and modern, such sanctity can only be explained in one way—the spirit of some dead holy man or woman dwells in the trees. Manifestly the sacredness of this oak and lime, standing together, is best explained on the theory that a man and a woman—say, the original priest and priestess of the neighbouring temple—were changed into these trees. The temple itself is of an unusual sort—it is the shrine of two gods, worshipped in common. It stands near a lake, covering what was once habitable land—a sort of Dead Sea, covering the abodes of the wicked. Obviously the two gods were the authors of this local deluge, and we at once, with many analogies in our minds, recognise in Philemon and Baucis the Noah and his wife of a local legend of the flood, the only righteous survivors of a race of sinners overwhelmed in a deluge, meet and acceptable as the priest and priestess in the gods' temple. Next we examine the deluge itself, and we find that it was caused not by rain from heaven, but by water issuing out of the earth. This distinguishes our deluge, which we shall presently find to be of the normal Anatolian type, from the Semitic flood which is described in Genesis, in which the chief stress is laid on the rain from heaven. But surely Ovid will mention an ark? Nothing of the sort—in this version of the deluge the righteous are saved by walking up a hill. All these points are of significance to the student of Anatolian religion. There are two other points, referred to above, on which it would be rash to lay stress—the incident of the gander, and the production by the gods' hosts of a chine of pork. The gander reminds us that the Noah and his wife in many flood legends are associated with birds—in Genesis it is the raven and the dove, in the Chaldæan version it is a variety of birds—and we wonder whether the gander had not his place in the original legend. But then we reflect that Ovid required a motive for the self-revelation of the gods, and that the gander was a sacred bird at Rome (had he not saved the Capitol in an old cult legend?), and we feel disinclined to press this point. And when we read of the pork, we are reminded that Asia Minor lay as a debatable land between the "pig-eaters of Europe and the pig-haters of the Semitic East," and that tales of old feuds centring round the use of swine flesh were told in the temple-legends of the country. But here again we feel that we cannot press the argument, and we prefer to assume that Ovid regarded a gammon of bacon as an essential course in such a meal as a rustic would offer to an honoured guest.

Having thus cleared the ground, we pass on to consider those features in the story which we have provisionally marked as of Anatolian origin. But before doing so, we must glance at another feature in the story, a feature which it shares, I think, with only one other story in the *Metamorphoses*. The tale of Philemon and Baucis is connected with the preceding story by the flimsiest of devices; as Pichon says, Ovid's transitions from story to story in this work often depend on an accidental turn of phrase, sometimes even on a connecting or adversative particle. In this case, a speaker expresses scepticism regarding the preceding story, and is reproved by the teller of this story, who poses as an eyewitness of the trees, temple, and lake. "I saw the place myself," "Truthful elders, with no motive for deceiving me, told me the tale, and I saw the garlands hanging on the trees," etc. He would be a blind critic who would miss the significance of this feature in the story, shared, I repeat, by only one other story in the *Metamorphoses*, and that story also from the interior of Asia Minor. Ovid is at pains to tell us that his story of Philemon and Baucis is derived from someone who had been to the scene of the legend, and heard it from the lips of the peasants. I may add incidentally that the caution "they had no motive for deception" will be found *passim* in the writings of all moderns whose business it has been to elicit information from the peasants of Anatolia, who can never understand why they are asked for such information by inquisitive strangers from Europe. This trait is as genuinely Anatolian as any in the story.

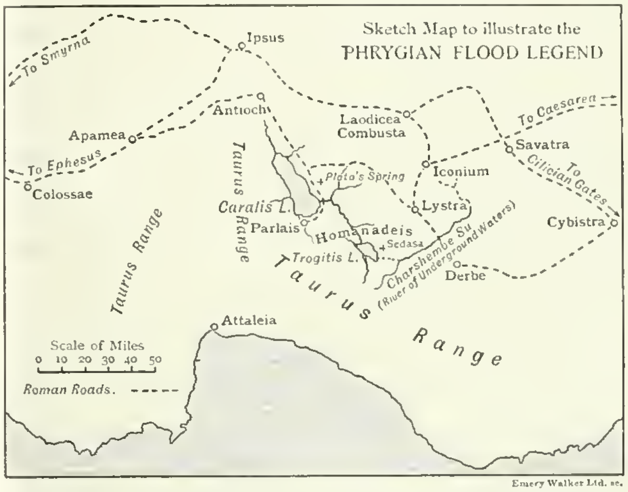
We see then that Ovid, writing about the turn of the centuries, is telling us the foundation-story of a temple of Jupiter and Mercury beside a lake in Asia Minor, reported by an eyewitness of the locality. The lake occupies ground formerly inhabited: the language used in the poem would suit either a marsh or a lake, but for Asia Minor the distinction is immaterial. In this land of seasonal rainfall, many of the lakes, and even some large ones, are seasonal, and

may be called lake or marsh according to the time of year.

Now let us consider the details of religious significance which we have detected in the story. First let us take the sacred trees. On this constant feature of the Anatolian landscape much might be written; I will content myself with a quotation from a book [1] by a modern traveller which is full of acute observation of the social custom of Asia Minor. My friend Mr. W. J. Childs, describing a tree in the Cilician Gates Pass which was covered over with pious rags and surrounded by a rampart of small stones placed there one by one by Moslem travellers, writes: "These sacred trees . . . are found wherever trees and bushes grow, are decorated always with rags, and surrounded by an accumulation of stones." "The best explanation I got was that these bushes mark the haunt of some dead holy man . . . at which, as at a shrine, offerings might produce lesser miracles, or at least be accounted as good works." Ovid's trees were covered with fillets and surrounded by a low wall. The fundamental things in the old Anatolian religion live on still, and the sacred bushes which every traveller sees in modern Anatolia are good evidence of the Anatolian character of the details recorded by Ovid.

Next let us take the story of the flood. We have noted that the flood in the Philemon and Baucis legend was caused by subterranean water, and that this feature distinguishes it from the Semitic version, in which the principal source of the flood was rain from heaven. The Anatolian versions of the flood legend regularly imply a deluge caused by water issuing out of the earth, as is natural in a volcanic land, where similar phenomena on a smaller scale are of common occurrence. In his story Ovid follows this Anatolian version, and follows it strictly; and this is a point of some importance, for Ovid was first and foremost a story-teller, with an eye for good copy, and he has a habit of accumulating picturesque detail without much regard to its consistency. This tendency may be observed in another flood story told in the *Metamorphoses*, the Greek version, with Deucalion and Pyrrha playing the part of Noah and his wife. In that story Ovid is manifestly drawing partly on literary sources and partly on his imagination, and here he actually derives his deluge both from heaven and from under the earth. Jupiter first sets the storm-clouds in motion, producing torrents of rain, and then calls on Poseidon to shake the earth and flood the rivers with subterranean waters. The contrast is significant. In the Deucalion story, drawn from literary sources, the Semitic and Phrygian methods are combined to produce a deluge worthy of the occasion. In the Philemon and Baucis story, derived from the truthful old men who lived near the lake, only the Phrygian method is used.

The Phrygian or Anatolian story of the flood is known chiefly from the legends which two Phrygian cities, Apamea and Iconium, told regarding their origin and early history. Both these cities lie on that somewhat unstable portion of the earth's crust which lines the northern slope of the Taurus range. Here extinct volcanoes, numerous hot springs, and frequent earthquakes reminded the ancient population that they lived in a land where Zeus or Poseidon, if strong to save, was also strong to smite. Of the rivers of Apamea, bursting full-grown from the earth, many strange old tales were told; it was here that the Sibylline Books located Mount Ararat, identifying it with the mountain overhanging the Marsyas, a river famous in story



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Here an abyss opened in the earth, to close again only when the king's son plunged into it, in panoply, on his steed. And here, in later days, we find a legend on the coins of the city which is unexampled in the whole Roman world. Coins struck in the earlier part of the third century of our era represent an ark with a man and a woman in it, and with the name of Noah written on it. Now it is well known that there was a large body of Jews among the citizens of Apamea; but the same was true of many cities in Asia Minor; yet it was only at Apamea that the legend of Noah was represented on the coins. The problem was thoroughly investigated by a young Jewish scholar, one of the first French officers to fall in the war, in a book published in 1913,[2] and he was able to supply convincing proof that the legend of the flood had been located at Apamea from remote antiquity, and that the Jewish version was simply superimposed on the old Anatolian story. The flood-story lasted on in this district till Byzantine times, when, according to the local tradition, a deluge threatened to overwhelm Colossæ. The city which had

[1] *Across Asia Minor on Foot* (Blackwood & Sons, 1918), p. 321.

[2] *Noé Sangariou*, by Adolphe Reinach, Paris, 1913.

been specially warned by the Apostle Paul against the worship of angels was on that occasion saved by the archangel Michael, who hacked out the gorge west of the city, and allowed the water to escape. The gorge is there for all to see ; for the Christians it represented the beneficent act of Michael, just as by the pagans it had no doubt been attributed to the trident of Poseidon or the *harpe* of Perseus.

It is, however, with the Iconian version of the flood legend that we are mainly concerned. The Byzantine chroniclers preserve the story of a King Nannakos who ruled at Iconium for 300 years, and foretold a flood which was to overwhelm his people. The flood took place, and the new race was created by Prometheus and Athena out of mud—the *eikones* of mud thus formed giving its name to the city (Eikonion in the Greek version). This is a familiar type of foundation-legend, turning on the name of a city. The evidence for this story is late ; but the recently discovered mimes of Herondas [1] show that the story of Nannakos had become proverbial on the coast of Asia Minor in the third century B.C., and the story in itself has all the marks of great antiquity.

But we are not dependent on the Byzantine chroniclers, or even on Herondas, for proof that the story of the flood had an Iconian version. The myth of a local deluge lingers on in the folk-lore of Iconium till the present day. The Moslems relate that the city was once threatened by a flood from a mountain valley lying to the west, but that Plato (the Arabian counterpart of Virgil the magician) stopped up the hole through which the water passed. And if you visit this valley, you will find a fine fountain issuing from beneath a Hittite monument, and locally known as the " spring of Plato." Plato is simply the Moslem counterpart of the Christian Michael and of the older Perseus, a god who looms large in the early history of this neighbourhood, and who is known elsewhere as a drainer of marshes and a reclaimer of agricultural land.

Iconium lies on the western edge of an arid desert, formed of one of the richest tracts of soil in the Mediterranean area. All the elements of fertility are present in this Lycaonian plain, except water. The district immediately around Iconium is a belt of surpassing fertility—which it owes mainly to a river running down from the Isaurian hills and losing itself in many channels in the plain. An old Arab geographer calls this the River of Underground Waters, and with this description in mind we may ascend the river valley to its source. Here we are confronted by a strange situation.

The water which feeds this river comes mainly from the Taurus range, far to the south. But it is said to be fed at times also from a lake of peculiar behaviour. This lake, called in ancient times Lake Trogitis, lies at the bottom of a large catchment area, and is separated by a low rim from a canyon which runs down to the River of Underground Waters. Sometimes Lake Trogitis, which is continuously fed by a large stream coming from the larger Lake Caralis, rises sufficiently in height to run over this rim and discharge into the plain of Iconium ; normally it runs off through an underground passage to the south, and occasionally, at long intervals, say the natives, it dries up completely. The engineers of the Baghdad Railway Company diverted the stream which feeds Lake Trogitis into the plain of Iconium, and had actually contracted to drain the greater part of the area covered by the lake. But the lake refused to be drained, and remained obstinately at its old level. Such a body of water as this, behaving capriciously, draining off at will into the plain of Iconium or into the southern sea, rising in level and disappearing as if at the bidding of some unseen power, naturally becomes the focus of strange tales. The few archæologists and other travellers who have visited this lake all record the story told by the natives on its shores, that when at rare intervals the lake dries up completely, an ancient town appears at the bottom.

Here indeed is a lake which might well give rise to such a legend as that told by Ovid—a lake lying in a region from which Iconium folklore brought the Iconian flood, appearing and disappearing mysteriously, covering rich agricultural land, and, according to the local myth, with an ancient town lying in its depths. But is it only a fancy of mine that Ovid's story came from this lake ? It lies in a remote nook in the mountains, far from the great routes of trade and administration which crossed Asia Minor in Ovid's day. Can we claim it as even probable that Ovid had so much as heard of it ?

I have already described in DISCOVERY [2] what was happening in this region a few years before Ovid wrote the *Metamorphoses*, and while he was collecting the material for his book. Quirinius, the Governor of Syria mentioned by Luke in the passage in which he dates the birth of Christ, was engaged between 11 and 6 B.C. in a war for the pacification of Pisidia, which, from the name of the tribe which was the principal enemy and gave most trouble to the Roman army, was called the Homanadensian War. The war was a success for the Roman arms. Only two facts concerning it need be repeated here. It was over in 6 B.C., and the principal scene of operations was the country round Lake Trogitis, the home of the Homanadeis. Quirinius, as Strabo and Pliny inform us, reduced their fastnesses one by one, took 6,000 men alive, and

[1] Mime III, l. 10 (Nairn's or Headlam's edition). See also Ramsay, *Cities of St. Paul*, p. 319.

[2] April 1920, pp. 100 ff.

planted them in the neighbouring cities. Clearly his army got to know the valley of Lake Trogitis very thoroughly. About 6 B.C. Quirinius returned to Rome, where he was honoured as a conqueror, and no doubt many of his officers accompanied him. Ovid, who moved in the best society, would have ample opportunity of hearing the story of Lake Trogitis.

Strangely enough, we can prove a good knowledge of the topography of Lake Trogitis in the case of at least one Roman officer. It has always puzzled those students of Strabo who know the country he is describing that he twice makes reference to Lake Trogitis, without being aware that on both occasions he is referring to the same lake. Strabo travelled widely in Asia Minor, and in the first of the two passages he lets fall a hint which shows us the route by which he crossed Lycaonia. He mentions the city Savatra, where the wells are so deep that you buy water at so much a bucket, and the sheep are fat and fleecy—obviously an eyewitness account, proving that he had passed by Savatra, and therefore along the northern branch of the Syrian Highway, which does not touch Iconium. But he is quite explicit on the point himself. He goes on to say, "and in that region lie Lakes Caralis and Trogitis, and somewhere hereabouts Iconium"—evidently he had not been to Iconium or the lakes. Now this is strange, for a few pages farther on he gives us an admirably exact description of the military topography of the valley of Trogitis. He is now describing the Homanadensian War, and says that it was fought in a region of crags and precipices surrounding a fertile plain, divided into several canyons, and defended on all sides by mountains. This is obviously the description of a military eyewitness, and Ramsay acutely discerned that Strabo got it from one of Quirinius' officers, and used it without being aware that it referred to Lake Trogitis which he had already mentioned.

If information regarding Lake Trogitis was accessible to Strabo (wherever he wrote; there is doubt on the point), it was accessible to Ovid in Rome when he was collecting materials for his *Metamorphoses*. We have now seen that Lake Trogitis—that mysterious lake which accords so well with Ovid's story—was *the one lake* in Asia Minor which is certain to have been much talked of in Rome after the year 6 B.C. And we have seen that Ovid's story of Philemon and Baucis—an eyewitness story—is a genuine Anatolian legend, answering to every test of local veracity that we can apply to it. I venture to think that few cases which have been made out for an ancient literary origin are more substantial.

But this is not all. So far I have set out the case for the location of Ovid's legend at Lake Trogitis as it can be established by independent witnesses. One day in 1909 our party visited the lake, and in the evening (to avoid the mosquitoes) we rode up the long slope to the high ledge which overlooks the lake on the east. By such trivial considerations is discovery often guided. We passed the night in a village which had already been visited by the American Sterrett, who found evidence that it was one of the villages of the Homanadeis, called Sedasa. Near Sedasa we were fortunate enough to find an inscription which told us that on this ledge, in the Greek and Roman periods, there had stood a temple of Jupiter and Mercury.[1]

The writer's realisation of the bearing of this discovery on Ovid's story has followed from Ramsay's[2] brilliant reconstruction of the topography of the Homanadensian War, recently published. Its bearing on another story told of this neighbourhood was plain to us at once. One of the series of garrison cities founded by Quirinius to control the Pisidians, and the nearest of the whole series to Lake Trogitis, was Lystra. Lystra was visited some fifty years later by Paul and Barnabas, and there Paul healed a lame man. "And when the people saw what Paul had done, they lifted up their voices, saying in the speech of Lycaonia, The gods are come down to us in the likeness of men. And they called Barnabas Jupiter, and Paul Mercurius."

For the story of Philemon and Baucis see Ovid's *Metamorphoses*, viii. ll. 611–724; trans. by F. J. Miller in the Loeb Classics. (Heinemann.)

The British Association

A Retrospect[3]

To many people the British Association still conjures up an image of the tame scientist, a curious kind of fellow who may be suffered to live, but who in life may be safely ignored. It is well known that this is no longer a true image, but once it was; and it exists to-day because it is an inheritance of the past. In 1831 when the British Association was founded the scientist was indeed a tame scientist, a harmless curiosity, not only in England but wherever he flourished. A remark by a lounger in a Hamburg café in 1830 that a scientist was passing up the street led to an animated scene of which we have a record. Immediately after it was made there was a "hustling and a justling, a knocking over of chairs and tables, and a scrambling for hats, as everyone hurried to the door to see what the animal was like, and if it walked

[1] Published by the writer in *Classical Review*, 1910, pp. 76 ff., and *Expositor*, July 1910, pp. 1 ff.

[2] *Journal of Roman Studies*, vii. pp. 229 ff.

[3] *The British Association for the Advancement of Science.* A Retrospect, 1831–1921. By O. J. R. Howarth, O.B.E., M.A. (London: The British Association, 7s. 6d.)

on two legs or four on its way up the street." But even worse than to be regarded with curiosity or contempt is to be ignored altogether. "There is not at this moment, within the British Isles," complained Sir David Brewster in 1830, "a single scientist, however eminent have been his services, who bears the lowest title that is given to the lowest benefactor of the nation, or to the humblest servant of the Crown!" This was true enough if we consider James Watt, not, however, if we consider Sir David himself. Yet things were bad for scientists in those days. For them no pensions, allowances, or sinecures; no favours from the sovereign, no friendships with his ministers. Recognition, power, fame were still to come; the Orders of Merit and of the British Empire had still to be instituted; not then was that home of science, Cambridge, a beknighted city.

The British Association was founded to better this wretched condition. Its founders were Sir David Brewster, John Phillips the geologist, and the Rev. W. Vernon Harcourt, chemist and Canon of York. Its object was to advance science by giving a stronger impulse and more systematic direction to scientific inquiry, to obtain a greater degree of national attention to the objects of science, and to promote the intercourse of the cultivators of science with one another and with those from abroad. To the first meeting, held in York under the presidency of Lord Milton, afterwards the third Earl Fitzwilliam, came 200 friends of science. The early meetings became at once successful. Dalton attended. Cambridge sent Sedgwick, Airy, Herschel, Babbage, and Lubbock; London, Faraday, Owen, Wheatstone, and Lyell. From Ireland came Lord Rosse and Sir William Hamilton, and, from the Continent, Bessel, Liebig, Leverrier, and Jacobi. The meetings were originally for men only. It was thought that if ladies were admitted to any of the scientific discussions the proceedings would lose their real value and degenerate—"especially in a place like Oxford—into a sort of Albemarle-dilettanti meeting."

The York meeting was a great success and the Association found its feet at once. There was, however, opposition to be encountered and quashed. Some did not like the rule that the annual meetings be held only in the provinces; some thought the Association was being used by its founders to advertise themselves unnecessarily; others were simply shy. Lockhart of the *Quarterly Review*, and even Charles Dickens attacked it. Many sneering and pseudo-scientific humbugs maligned it. *The Times* showed uncompromising hostility. When the Association held its second meeting in 1832 at Oxford the honorary degree of D.C.L. was bestowed upon some of the most distinguished members of the Association. Yet Keble, at that time a leader of university thought, found time to write, "The Oxford Doctors have truckled sadly to the spirit of the times in receiving the hodgepodge of philosophers as they did." The hodgepodge of philosophers were Robert Brown (of the Brownian movement), Sir David Brewster, Michael Faraday, and John Dalton, great scientists all!

But none of these things worried the Association much. Slowly it grew in numbers, repute, and power. In 1833 there were four sections, in 1836 seven; to-day there are thirteen. Geography became a separate section in 1851, anthropology in 1884, physiology in 1893, educational science in 1901, agriculture in 1912, and psychology in 1921. There is no record of a section once formed being afterwards disbanded, and though some were objected to at the time of their formation, all have eventually justified their establishment. Another thing illustrative of the Association's power and influence is the number of smaller scientific societies to which it has given birth. Important and flourishing societies in Edinburgh, Glasgow, Birmingham, Norwich, Bradford, Southampton, and Aberdeen were founded as a result of, and soon after, the meetings of the Association in those cities.

A feature of the British Association has been the overseas meetings. The first of these was held in Montreal in 1884. An American Association for the Advancement of Science had been founded in 1848 on the lines of the British one. This society met in Montreal in 1882 and to it they invited British scientific men, offering many inducements, but the response was very poor. Yet it helped to popularise the suggestion of holding a meeting outside England. Opposition, however, was strong. Why should eminent scientists travel across the Atlantic to visit a land not great in science? It could only be because they regarded the trip as a picnic, or because they could add to the joy of an agreeable outing the pleasure of showing off or of being wondered at. The Canadians, some of them at least, were also dubious. They foresaw audiences small and uninspired: "the mind of the average fashionable gathering is not scientific; it is not even literary in the most meagre sense; it very hazily comprehends Oscar Wilde; it fails to grasp Professor Tyndall or Professor Huxley." Nevertheless the Association went overseas more than nine hundred strong; they saw and conquered. The whole adventure was a great success. Numerous excursions were arranged; the American Association was invited to Montreal, and it invited the British Association to Philadelphia; everybody was pleased, and even some scientific work was done. Since then the Association has crossed the sea four times: to Toronto in 1897, to South Africa in 1905, to Winnipeg in 1909, and to Australia in 1914. All of these meetings have been

successful, and the most popular of all was the Australian meeting in 1914.

The meetings of the British Association have been the scene of many famous discussions. New theories or discoveries have rarely been disclosed for the first time at these meetings, but often they have been announced there for the first time in a popular or semi-popular form, or described for the first time so that discussion is possible. In that age—" so rich in minds of the first order in science . . . the golden age, not of art or of poetry, not of drama or of adventure, but of science . . . an epoch distinguished by a galaxy of men who made it great, and who, whether the world recognised it or not, were great men " (as Silvanus Thompson described it)—discoveries were innumerable and a few of them only can be singled out here. In 1860 at Oxford there was the famous discussion on Darwin's *Origin of Species*, in which occurred Huxley's retort to Bishop Wilberforce of which every book that describes it gives a different version. In 1877 at Plymouth Sir William Preece demonstrated various types of the newly-invented telephone. In 1888 at Bath Fitzgerald announced Hertz's verification of Clerk Maxwell's theory of electro-magnetic waves. In 1894 at Oxford Ramsay described the isolation of the new gas argon, and at the same meeting Sir Oliver Lodge gave one of the earliest demonstrations of wireless. At Dover in 1899 Sir Joseph Thomson described " the existence of masses smaller than the atoms "—the electrons. At Leicester in 1907 Duddell, in giving an evening lecture on the arc and spark in radio-telegraphy, showed experiments which formed the foundation for continuous-wave telegraphy. At the Oxford meeting in 1894 there was a discussion on Maxim's flying machine, and it is interesting to note that this early example of the aeroplane was then described by Lord Kelvin as " a kind of child's perambulator with a sunshade magnified eight times." Two recent discussions of outstanding importance were that on the Constitution of the Atom, opened by Sir Ernest Rutherford at Leicester in 1907, and that on the Age of the Earth opened at Edinburgh last year by Lord Rayleigh.

The public lectures also have been an important feature of the Association's meetings These were given by scientists not to fellow-scientists, but to the general public or to working-men. One of the earliest of these was given away back in 1838, by Adam Sedgwick, the geologist, at the meeting at Newcastle, and is described by Sir John Herschel in a letter as follows:

" But this was nothing compared to an out-of-door speech, address, or lecture, which Sedgwick read on the sea-beach at Tynemouth to some 3,000 or 4,000 colliers, . . . which has produced a sensation as is not likely to die away for years. I am told by ear- and eye-witnesses that it is impossible to conceive the sublimity of the scene, as he stood on the point of a rock a little raised, to which he rushed as if by a sudden impulse, and led them on from the scene around them to the wonders of the coal-country below them, thence to the economy of a coal-field, thence to their relations with the coal-owners and capitalists, then to the great principles of morality . . . and happiness and their own future prospects. . . ."

For these lectures, of course, the very best men were selected, for if there are few things better than a scientific lecture given by a man who says exactly what he means, without confusion and without obscurity, and saying neither too much nor too little, there are few things worse than the opposite. Tyndall started the series in 1867 with a lecture on " Matter and Force," Huxley following with " A Piece of Chalk." Silvanus Thompson was a past master at this work. In 1891 at Cardiff he spoke on the uses of electricity in mining to a crowded audience of miners who were brought by special trains to hear him speak ; again at Bradford he spoke to an audience of 3,500 for an hour and three-quarters, discussing the applications of electricity to industry as a national question, and at the close elicited a " manifestation of feeling . . . such as is generally associated with a great political meeting, rather than with a scientific lecture." The popular lectures to the public are nowadays one of the most delightful of the Association's activities, and one of the best means of securing one part of the Association's object.

Mr. Howarth's book, from which the description above has chiefly been obtained, is an exceedingly interesting and informed account of the British Association's activities during the past ninety years. The author, as secretary of the Association, has been enabled to write from inside information. In addition to accounts of the history and organisation of the Association and the progress of science, the book contains chapters dealing with the Association and research, the Association and the state, a description of some Association researches, and a discussion of its present position, work, and prospects. There are appendices showing the grants paid by the Association in aid of research, and giving the dates and places of the annual meetings with biographical notes of presidents and other prominent members. The illustrations are a feature, and these include photographs of eleven great scientists: Brewster, Vernon Harcourt, Phillips, Murchison, Huxley, Tyndall, Sedgwick, Whewell, Kelvin, Crookes, and Rayleigh. We like best those of Phillips in his old-time Pickwickian costume, of Whewell, big and dour, almost a cross between Beethoven and Liszt, and of Kelvin, gentle and serene,

like a retired Clyde-steamer captain about to fill his second pipe.

The book is altogether a good one, and should be welcomed by everyone who is privileged to take an interest in science.

In talking of the British Association's past we need not forget it has a future too. In 1924 it hopes to meet in Canada. This year it meets in Hull. It met there once before, in 1853, with Hopkins the geologist as president. This time Sir Charles Sherrington is in the chair. His subject will be "Some Aspects of Mechanism." Several of the addresses of the sectional presidents will deal, as befits a meeting in Hull, with North Sea problems. Among the subjects of joint discussion will be "The Origin of Magnetism," "Psycho-analysis and the School," "Mental Characters and Race," "The Present Position of Darwinism," and "The Possibility of Increasing the Food Supply of Great Britain." Dr. F. W. Aston will give an evening discourse on "The Atoms of Matter," and Prof. W. Garstang one on "Fishing: Old and New."

A. S. Russell.

Modern Road-making in Cities

By George Whale

The enormous increase in the weight of vehicular traffic during the last ten years has awakened those responsible for the maintenance and construction of roads, both in the cities and the country, to the fact that new methods must be adopted to meet the altered conditions. Owing to the weight of the motor-omnibus, the motor lorry and steam wagon now universal in road transport, a good foundation and a solid one is absolutely essential. In the cities, therefore, cement concrete foundations are laid in all main thoroughfares which are paved with wood blocks, granite setts, or one of the various forms of asphalt, of which there are several to choose from.

Of these three types of paving the granite setts are the most durable, but they are extremely noisy and ill adapted for any streets except those in the vicinity of docks or warehouses. Wood paving compares very favourably with other types. It is easily cleaned and is practically non-absorbent, and traffic over it is more silent. It has a lengthy life and requires little or no repairs for several years. As compared with asphalt it is slightly inferior from a sanitary point of view and a little less silent, but on the other hand affords a much better foothold for horses and, if it is properly cleansed, vehicles are less likely to skid on it. For these reasons wood paving finds most favour with municipal engineers and is in general use in the principal carriageways of London and other large cities.

The work of repaving a carriageway with wood is one of considerable magnitude. The old blocks have to be stripped and taken away and the old concrete foundation broken up and removed. In its place a new concrete foundation is laid, 12 in. deep for heavy traffic and 9 in. deep for moderate traffic. Experiments are also being conducted in introducing metal reinforcing, which reduces the thickness of concrete required. The concrete foundations in the best class of work are composed of clean sharp ballast or crushed concrete and Portland cement mixed in a proportion of 6 to 1.

Until quite recently all this work was carried out by hand labour, but to-day several of the municipal boroughs of London are employing concrete mixing machines which, besides executing the work in a much better manner, effect a considerable saving in labour. These mixing machines move under their own power and require a complement of fifteen men. They are capable of spreading as much in one day as would be carried out by sixty men mixing concrete by hand.

The crushing machine, which is employed in crushing the best of the old concrete that has been broken out, is also a source of economy. On several road works carried out recently about 50 per cent. of new ballast was saved by using old crushed concrete, and a similar saving in carting away of old material was accordingly secured. On the top of the concrete foundation is laid an average depth of 1 in. of fine cement concrete, known as "floating," to afford a smooth and level bed for the wood blocks. This "floating," composed of clean sand and cement in proportions of 3 to 1, is also mixed by a light portable mixing machine.

The wood paving blocks are usually specified to be of the best Swedish yellow deal and to be cut from 3 by 9 in. planks. They are 8 in. or 9 in. long, 3 in. wide, and 4 to 5 in. deep. The blocks are placed in a cylinder, which is raised to a temperature of 200 degrees Fahrenheit. The steam is exhausted from the cylinder by means of an air pump, and creosote is forced into the blocks at a pressure of not less than 120 lb. to the square inch and to an amount of not less than 8 lb. to each cubic foot of timber. The blocks when laid are thoroughly "grouted" with pitch and creosote oil mixed in proportions of 8 to 1 and then washed over with liquid cement. Finally they are covered with $\frac{3}{8}$ in. of crushed shingle, and the road is then ready to be reopened for traffic.

Even with the introduction of machinery wood paving renewals are a costly business, and the esti-

mated cost of such works for the present year is about £2 15s. per square yard. Labour, so much of which has to be devoted to the breaking out of the old concrete, absorbs much of this cost. The breaking out is still done by hand to find work for unemployed men. When labour conditions have settled down, we may expect this portion of the work to be done by mechanical drills, and a further considerable saving in expenditure may be looked for.

The life of a wood carriageway is from twelve to fifteen years under heavy traffic conditions and from eighteen to twenty years under moderate traffic, but it is anticipated that the actual modern foundations themselves will last very much longer. Periodically the wood blocks and the "floating" will require renewal, but this is an inexpensive business compared with relaying the foundation.

Considerable trouble has been taken of late years in adopting the best gradients and transverse inclinations, so as to afford ample opportunity for drainage and yet avoid undue cause for the skidding of heavy vehicles. A complete survey is now made of any road under order for reconstruction, and levels are taken to enable the new contours to be calculated. These, when completed, are set out scientifically, and the results may be said to justify the expenditure of time and trouble.

Minor thoroughfares are now paved for the most part with tar macadam or one of the bituminous macadams, of which there are so many on the market. In these works the foundation is composed of hard-core well rolled, and the tar or bituminous macadam coatings are spread in two layers, the bottom of coarse, the top of finer material, each well rolled and formed to gradients.

Experiments have been conducted also with roads composed entirely of concrete, but so far they have not been entirely satisfactory.

The main difficulty experienced in London is that no street remains in an undisturbed condition for any length of time. Water, gas, hydraulic mains, Post Office and electric lighting cables—all are laid indiscriminately beneath the surface. They are continually in need of repair, and, to effect this, the road is broken up and the continuity of its foundations impoverished. If it were possible to lay all these mains in a subway, there is no reason why the road foundations of to-day should not last a hundred years.

The Metropolitan Paving Committee recently issued its annual report, which showed that all the boroughs are working on more or less similar lines to those outlined above. Vehicles, however, seem to grow heavier day by day, and it may be doubted if even the methods at present in use will prove to be sufficient for very long.

The Fate of a Great Lyric Poet

II

By Edward Liveing, B.A.

(*Continued from July No., p.* 188)

VI

THE true details of Shelley's death and the sinking of the *Ariel* will never be known. Various theories have been put forward. I propose to amplify one of those theories, but before proceeding to do this it would be as well to return to Roberts and Trelawny. Roberts, as we have already noted, kept the boat in view till it was "off Via Reggio, at some distance from shore, when a storm was driven over the sea. It enveloped them and several larger vessels in the darkness. When the cloud passed onwards, Roberts looked again, and saw every other vessel sailing on the ocean except their little schooner, which had vanished."[1] The storm-cloud broke over Leghorn about half-past six, according to Trelawny.[2] The storm lasted about twenty minutes. After it had passed over he "looked to seaward anxiously in the hope of descrying Shelley's boat amongst the many small craft scattered about. I watched every speck that loomed on the horizon, thinking that they would have borne up on their return to port, as all the other boats that had gone out in the same direction had done."

The only facts which are at all certain are that the *Ariel* perished during, roughly, a twenty minutes' storm, some time between four and five o'clock in the afternoon of July 8th, about ten miles off Via Reggio. Now let us consider the theories of the disaster, which may be conveniently summarised as follows:

(*a*) The boat merely sank in the storm.

(*b*) It was accidentally rammed by one of the Genoese fishing boats.

(*c*) It was intentionally rammed.

We can dismiss (*a*) without more ado, since evidence in support of (*b*) at least is to-day so strong that, I imagine, no modern student would believe that the accident was entirely accounted for by the storm. While Trelawny was at Rome, burying Shelley's ashes in the Protestant cemetery there, Roberts concerned himself with recovering the *Ariel*. According to Trelawny the two *felucche*, which he had hitherto employed on the salvage operations, had found the boat, but failed to raise her. In September Roberts[3] wrote to Trelawny from Pisa, "We have got fast hold of Shelley's boat, and she is now safe at anchor off

[1] Ref. IV. P. 673. [2] Ref. V. Pp. 107–108.
[3] Ref. V. P. 150.

Via Reggio." Dr. Biagi's [1] investigations in 1890 have put beyond doubt that the *Ariel* was found and towed into port by two fishing-smacks belonging to a certain Signor Stefano Baroni of Via Reggio. On September 18th Roberts again wrote to Trelawny, and his letter shows that he had begun to consider that the *Ariel* had been run down. The two masts had been carried away, the bowsprit broken off close to the bows, and the gunwale stove in. But further examination brought to light more tell-tale evidence—many of the timbers on the starboard quarter had been broken. Roberts' belief that " she must have been run down by some of the feluccas in the squall " was shared at the time by most persons who saw the salvaged boat. Mrs. Shelley wrote to a friend on May 3rd, 1823 [2] :

" It is plain to every eye she was run down from behind. On bringing her up from fifteen fathoms, all was in her—books, telescope, ballast—lying on each side of the boat without any appearance of shifting or confusion ; the topsails furled, topmast lowered ; the false stern . . . broken to pieces, and a great hole knocked in the stern timbers. When she was brought to Leghorn, everyone went to see her, and the same exclamation was uttered by all, ' She was run down '—by that wretched fishing-boat, which owned that it had seen them."

Later biographers have been uncertain as to whether the *Ariel* was rammed at all. Dr. Garnett [3] concluded that " the collision, if collision there was, was accidental " ; Prof. Dowden preferred to pronounce no definite verdict on the subject ; Dr. Biagi agreed with Garnett that the storm would have rendered any *intentional* running-down impossible, but he definitely concluded that the boat was accidentally rammed. That the boat was not merely sunk by the storm there seems on the whole to be little doubt, and we will now look at further evidence which does not only support this conclusion but leads to the third theory, that the *Ariel* was rammed intentionally.

Now, on the day following the disaster, Trelawny [4] and his Genoese mate examined as carefully as they could the crews and boats that had returned to harbour. The mate noticed on board a fishing-boat " an English-made oar that he thought he had seen in Shelley's boat." The crew flatly denied this. Their obvious reason for doing so was, as Trelawny indicated, the fear of the quarantine laws, then so strict, that " when at sea, if you render assistance to a vessel in distress, or rescue a drowning stranger, on returning to port you are condemned to a long and rigorous quarantine of fourteen or more days." So, even if they had rammed the boat accidentally, they would have wished to conceal the fact. The Genoese mate held suspicions as to the veracity of the crew, and he must have had a thorough knowledge of the psychology of the seamen of his own coast.

Apparently, however, the captain of the felucca asserted that he had seen Shelley's boat " go down off Via Reggio, with all sail set " (Trelawny, p. 117) Also " when the *Bolivar* arrived off Via Reggio on August 14th, she fell in with two small vessels hired by Trelawny at Leghorn for the purpose of ascertaining, by the means used to recover vessels, the spot at which Shelley's boat had foundered. They had on board the captain of a felucca in which Roberts had observed several spars belonging to the *Ariel*. The captain declared that he had seen the *Ariel* at the moment of her disappearance ; it was four in the afternoon, the boy was at masthead, when thwart winds struck the sails ; they had looked away for an instant, and looking again the boat was gone. They could not, said the captain, get near her, and passing three-quarters of an hour later over the spot where they had seen her, no wreck was visible." [5] It was this man apparently who conducted the dredging operations between August 13th and 19th, and eventually reported that he had " succeeded in finding her, but failed in getting her up." [6]

Trelawny was too occupied during this time with the cremation of his friends' bodies and the official formalities connected therewith to be able to do more than rely on this man's statements. Immediately afterwards he proceeded to Rome, as we have seen, and entrusted the salvaging of the boat to Roberts. As we have also seen, the boat was eventually found accidentally and salvaged by two fishing-smacks belonging to Signor Stefano Baroni—and it was found about fifteen miles out, not two. In fact, Trelawny's account of the attempts to recover the boat has the inevitable inaccuracies of a man who was not on the spot, and it is noteworthy that as late as 1875 [7] he still entertained

[1] Ref. I. He gives an extract from the Royal State Archives of Lucca, Home Affairs, 1822, No. 95, Duchy of Lucca (letter of Governor of City of Via Reggio to Secretary of State for Home and Foreign Affairs, Lucca) : " The two fishing-smacks belonging to Sig. Stefano Baroni of Via Reggio have, while fishing, discovered at the bottom of the sea, at the distance of about fifteen miles from shore, a small vessel, schooner rigged. . . . They arrived (*at Via Reggio*) towards noon this morning." Also one of the eight natives of Via Reggio, whose knowledge of the disaster Biagi examined in August 1890, stated that " he belonged to the crew of Baroni's *paranzelle*, commanded by Giampieri, who recovered the schooner in the roads at Via Reggio, precisely five miles out, in the direction of the Tower of Migliarino. The schooner caught in their net," and they towed her westward and beached and bailed her. They afterwards towed her into Leghorn.

[2] Letter from Albaro to Mrs. Gisborne.

[3] In his article, " Shelley's Last Days," quoted by Dowden.

[4] Ref. V. Pp. 108–117.

[5] Ref. II. Pp. 579–580.

[6] Ref. V. P. 117.

[7] Ref. V. P. 116.

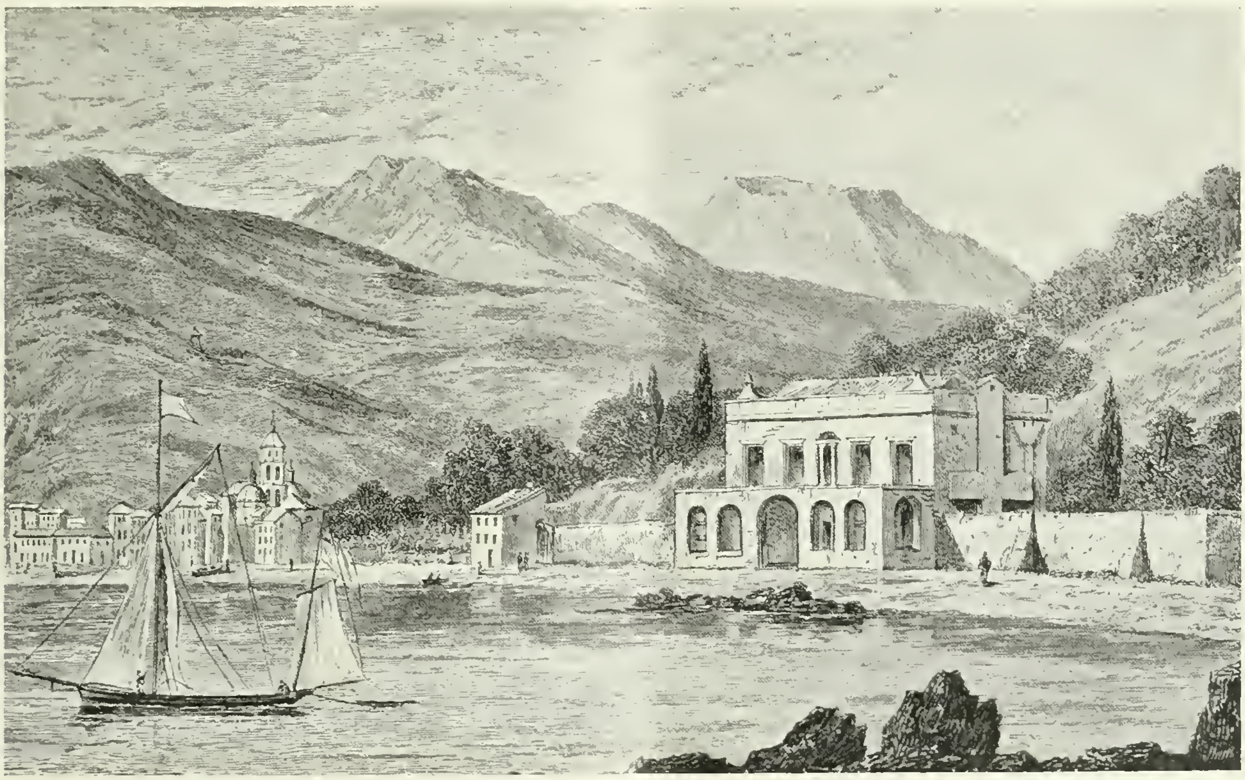
the belief that the *Ariel* was found only two miles out from Via Reggio. Who put this idea into his head? As I see the matter, none other than this man who was in charge of the dredging operations till Trelawny departed for Rome, the captain, apparently, of the felucca in which both Roberts and Trelawny's mate had observed several spars belonging to the *Ariel*. The question which one naturally asks is, "Why did this man report that he had found the boat only two miles from shore, but could not get her up?" And the answer which arises in one's mind is, "Because he realised that its broken timbers would serve as a witness against him, and that, therefore, any subsequent search-parties must be misled."

Before proceeding, I must say that this is a conjecture of which I am by no means certain, and, even if we dismiss it, this does not affect the other arguments that the *Ariel* was run down intentionally. Even at the time of the disaster, as Leigh Hunt[1] wrote, "a suspicion was not wanting that the boat had been run down by a larger one with a view to plunder it. Mr. Shelley was known to have taken money on board. Crimes of that nature had occurred often enough to warrant such a suspicion." This view of the case received further support in 1875, when Trelawny's[2] daughter wrote to him from Rome on November 22nd, that "a little while ago there died at Spezzia an old sailor, who, in his last confessions to the priest (whom he told to make it public), stated that he was one of the crew that ran down the boat containing Shelley and Williams which was done under the impression that the rich 'milord Byron' was on board with lots of money.

"They did not intend to sink the boat, but to board her and murder Byron. She sank, he said, as soon as she was struck."

Miss Trelawny's letter was published in *The Times*, and a violent correspondence ensued. Sir Vincent Eyre wrote (December 28th) that he had been given the version of this boatman's confession (made in 1863) as it had been handed on by the priest to an Italian nobleman and by the latter to his friend with whom he (Eyre) had earlier in 1875 been staying in the Bay of Spezia: "A boatman dying near Sarzana confessed, about twelve years ago, that he was one of five who, seeing the English boat in great danger, ran her down, thinking Milord Inglese was on board, and they should find gold."

Trelawny's suspicions of foul play were confirmed by this letter from his daughter. His letter to *The Times* (December 27th) contains two interesting state-



THE CASA MAGNI IN 1822, WITH THE BOAT (THE *ARIEL*) IN WHICH SHELLEY WAS DROWNED.
From a drawing by Captain D. Roberts, who built the "Ariel."

[1] Ref. III.

[2] Ref. V. Pp. 112–117.

ments not before made by him: (1) "Two feluccas went out of port at the same time, in the same direction as Shelley's boat." (2) "Her starboard quarter was stove in, evidently by a blow from the sharp bows of a felucca, and, as I have said, being undecked and having three tons and a half of iron ballast, she would have sunk in two minutes." Also in an Appendix to his *Records*[1] he gives explicitly his belief as to the intentions of the crew who ran down the boat: "They knew there would be a squall; in that squall they would run down the 'Don Juan' [the original name for the *Ariel*], drown the three people on board, and get the bag of dollars which they had seen taken on board. That was what tempted them. They succeeded in all but the last part; the boat's sinking so suddenly defeated their getting the money."

In the first instalment of this article I carefully mentioned the matter of Shelley's cashing £50, lent him by Byron, at Messrs. Webb and Barry's. He took it down to the boat in a canvas bag. "Byron, Shelley, Williams, and myself could not be distinguished by the sailors at the harbour," says Trelawny,[2] "and Byron's and Shelley's boats had their sails loose ready for sea."

Taking all the evidence into account, I am inclined to think that one of the two boats, which put to sea at the same time as the *Ariel*, rammed her in the belief that Byron was on board with the money seen either being cashed at the bank or taken down to the boat.

Or was the plot thicker than this? Byron had many enemies along the coast. In particular there was Masi, the affray with whom, on March 24th, I dealt with at some length in the first instalment, and who had sworn to have vengeance for his serious injuries. The questions naturally arise, "Did this man have a friend at Messrs. Webb and Barry's?" or, "Might not he or one of his friends have suggested to the captain of one of the two feluccas that, if he ran down the *Ariel* in the storm that was brewing, he would find a good prize on board?" I will not press this supposition further than recalling that—

(*a*) Masi had vowed vengeance not only on Byron, but on Shelley, and all the members of the "pistol party."

(*b*) He was a dogged type of individual whose plans of revenge were not likely to have cooled down within three months.

(*c*) Miss Trelawny's version of the old sailor's confession contains the sentence, "They did not intend to sink the boat, but to board her and murder Byron." Why did they wish to murder Byron in particular, when they obviously must have known or believed that he was not the only "Inglese" on board? Why is the word "murder" used in this version (*assassinare*, I take it, rather than *ammazzare*)?

[1] Ref. V. Pp. 263–264. [2] Ref. V. P. 115.

Shelley's body was thrown up on the Tuscan shore, near Via Reggio. It was found on July 16th or 17th. The tall slight figure, the volume of Sophocles in one pocket of the jacket and in the other the last volume of Keats's poems lately lent him by Hunt "doubled back as if the reader, in the act of reading, had hastily thrust it away," left no doubt in Trelawny's mind as to its identity, though the sea had already done its work.

(*Concluded*)

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V. Trelawny, E. J. *Records of Shelley, Byron, and the Author.* (George Routledge & Sons, Ltd., The New Universal Library.) First published in 1878, this book is a fuller record than the *Recollections of the Last Days of Shelley and Byron*, first published in 1858.

For further reading on the subject see references at end of first instalment of article.

Reviews of Books

THE ENGLISH VILLAGE COMMUNITY

The English Village: The Origin and Decay of its Community. An Anthropological Interpretation. By Harold Peake, F.S.A. (Benn Bros., Ltd., 15*s.*)

The Rural Community. By Llewellyn MacGarr, M.A. (Macmillan & Co., Ltd., 8*s.*)

Mr. Peake's study of the English Village Community is in many respects a notable achievement. It is the work of a scholar of wide reading and acute perception, who has a quick grasp of the essential in a mass of detail, and is able to see it in its proper perspective in relation to the broad outline of his thesis. Its outstanding feature, which to many will seem the most original, is the manner in which Mr. Peake has brought the results of recent anthropological research in the ethnology of Europe and of Britain to bear upon the problems of the origin and form of the Village Community as it appears in the historical records of this country.

Early Village Communities in England fall in the main into three classes: the Moorland Village, which is pastoral rather than agricultural, and is sometimes regarded as

" Celtic " ; the Valley Village ; and the Forest Village. Of these three, Mr. Peake deals at greatest length with the Valley Village, which he regards as a normal type in this country, the Moorland Village belonging to a more primitive form which survived only in the less favourable environment of a hilly and remote country, and the Forest Village being a later product of special conditions. The characteristics of the fully developed Valley Village Community are common possession of meadow-land for hay, arable fields cultivated in common on the three-field system, and a common pasture for flocks and herds. Usually, but not invariably, there is associated with the Village Community an overlord, who receives tribute from the members of the community, in service or kind, and acts as their protector and arbiter of disputes. The existence of an overlord in a social unit, which is essentially democratic and communistic, is an anomaly not hitherto satisfactorily explained.

The problems which the author has set himself to solve in the early part of his book are firstly, " What is the origin of these three types of community, and what are their relations one to another ? " and, secondly, " How is it possible to account for the anomalous position of the overlord ? " He has attacked these problems with a bold originality which some of his readers may think borders upon temerity, for in his suggested solution he has not only drawn upon the results of anthropological and archæological research, but he has ventured upon the more debatable ground of racial psychology. The extent to which his argument is recognised as valid will depend on the degree to which his readers are prepared to accept not only his theory of the persistence of mental characters, whether due ultimately to environmental or racial influence—a matter upon which Mr. Peake appears to have more or less an open mind—but also upon their agreement in his analysis of the different types of mentality which he associates with the physical differences upon which the racial classification is made to depend by the anthropologist. Although Mr. Peake's arguments may go far to convince, it must be remembered that they are based largely upon inference and personal impression. The scientific study of the association of mental character and race has far to go before the psychologist can speak with the authority of the physical anthropologist. Subject to this reservation it must be said that Mr. Peake makes out a strong case.

Only those who are acquainted with the works which Mr. Peake himself has published elsewhere will appreciate the originality of the summary of the ethnology of Europe in general and of these islands in particular upon which his anthropological argument is based. In order to give some idea of the force of this argument, it is necessary to indicate briefly the line which has been followed by Mr. Peake in his research. After summarising the theories which at present hold the field in regard to the development and relation of the different modes of life, hunting, pastoral, and agricultural, of primitive man, he maintains that the essential features of the agricultural form alone are such as would produce the material conditions and the habit of mind which, acting in combination, would be capable of originating and developing the Village Community. On cultural and psychological grounds, therefore, Mr. Peake holds that the origin of the Village Community may, with reasonable probability, be assigned to the Neolithic Lake Dwellers of Central Europe—the broad-headed Alpine race—by whom agriculture was introduced from Asia. As is well known, the races of Europe fall into three broad groups, the long-headed Mediterranean, represented in Britain by the early neolithic peoples, the broad-headed Alpine, and the long-headed fair Nordic peoples. To these is sometimes added a fourth group with Mongoloid affinities to which Mr. Peake, with adequate reason, is inclined to attribute more importance than most writers. Any problem, however, which depends for its solution upon the evidence afforded by racial characters is complicated by the fact that contact and admixture between these groups of peoples have produced intermediate varieties which have sufficient permanence to be regarded as sub-types. It is to one of these, the group of broad-headed peoples known as the Beaker-folk, who arrived on the east coasts of these islands a little before the introduction of bronze, that Mr. Peake would mainly assign the origin of the Moorland Village. The Beaker-folk he holds to be the result of contact between Nordic nomad pastorals and Alpines. About 1250 B.C. the Nordic tribes who inhabited the Russian steppes spread over the greater part of Europe, conquering the agricultural people whom they encountered and ruling over them as a military caste. The course of their wanderings, which extended to Great Britain and Ireland, has been traced by Mr. Peake by means of finds of their characteristic leaf-shaped swords, while the number of bronze sickles found in France and in this country have suggested to him that the Nordic conquerors brought with them as their subjects and followers a considerable number of the broad-headed agriculturists of Central Europe. On settling in this country, they founded a Village Community of the type with which they were familiar on the Continent in the form of the Valley Community on the three-field system, the Nordic leader developing into the village overlord.

The Forest Village, on the other hand, with its one or two-field system, Mr. Peake regards as a special product of the conditions which followed on the Anglo-Saxon invasion. As has been seen, he does not agree that the Anglo-Saxons originated the Village Community, as has sometimes been thought. He holds that they found it already in existence and adopted it, but were responsible for the Forest Village as a later off-shoot on the model of the one-field system of their home in North Germany.

This brief and inadequate summary must suffice to indicate the trend and quality of the author's line of reasoning ; nor is it possible to deal with his account of the development of the Village Community in mediæval times and its gradual decline and extinction. In this he is on more familiar ground. His forecast in the final chapter of a possible rebirth of the Village Community suggests a comparison and a contrast with Mr. MacGarr's careful study of the Rural Community in America, where, notwithstanding the difference of conditions, the problems to be faced are fundamentally the same. Their solution,

as both authors indicate, lies in the success of the attempt to secure for the inhabitants of rural districts a fullness of life and interest, upon lines which each suggests, to counter the attractions of the conditions of life in a town.

E. N. Fallaize.

A POPULAR EXPOSITION OF EINSTEIN'S THEORY

The Theory of Relativity and its Influence on Scientific Thought. By A. S. Eddington, M.A., F.R.S. (Clarendon Press, Oxford, 2s.)

Professor Eddington's " Romanes Lecture " is as good a Romanes as we have heard or read, and we are giving two somewhat lengthy extracts from it in the hope that they will send readers to the original. The first describes a deduction from Einstein's theory not usually mentioned in popular expositions of it ; the second draws an interesting comparison between a flat earth and a flat world.

I will conclude this part of the argument with an experimental application which illustrates the power of Einstein's method. Much study has of late been given to electrons moving with very high speeds ; for example, the β particles shot off from radio-active substances are negative electrons which sometimes attain speeds of 100,000 miles a second. It is found by experiment that the rapid motion produces an increase of mass of these particles. I want to show that the theory of relativity gives a very simple explanation of just how this increase of mass occurs. But I must first remark that an explanation had been previously given which had generally been accepted as satisfactory. The phenomenon was actually predicted by J. J. Thomson before relativity was thought of ; because, assuming that the mass of a β particle is of electrical origin, an application of Maxwell's equations shows that it ought to increase with velocity. But the precise law of increase cannot be predicted on this basis, since various plausible assumptions lead to slightly different results. . . . Einstein takes us straight to the root of the mystery, and he clears up one point which was misleading, if not actually wrong, in the older explanation. The change of mass does not in any way depend on whether the mass is of electrical origin or not ; it arises simply from the fact that mass is a *relative* quantity depending by its definition on the relative quantities length and time. Let us look at the β particle from its own point of view ; it is just an ordinary electron in no way different from any other. " But it is travelling unusually rapidly ? " " That," says the electron, " is a matter of opinion. So far as I am aware I am at rest, if the word ' rest ' has any meaning. In fact I was just contemplating with amazement *your* extraordinary speed of 100,000 miles a second with which you are shooting past me." Of course our motion is of no particular concern to the electron, and it will not modify its condition on our account, so it keeps its mass, radius, electric field, etc., equal to the standard constants applying to electrons in general. These terms are relative, and refer therefore to some particular frame of space and time—clearly the frame appropriate to an electron in self-contemplation, viz. the one with respect to which it is at rest. But this frame is not the usual geocentric frame to which *we* refer quantities such as length, time, and mass ; there is a difference of 100,000 miles a second between our station of observation and that of the β particle in self-contemplation. It is a mere matter of geometry to discover what the β particle's lengths and times become when referred to the partitions which we have drawn across the world. But when we calculate the consequential change of mass resulting from the changes of length and time, we find that it should be increased in precisely the proportion indicated by the most refined experiments.

The ancients believed that the earth was flat. The small portion of its surface with which they were chiefly concerned could be represented without serious distortion on a flat map. As more distant countries were added, it would be natural to think that they also could be included in the flat map. You have all seen such maps of the world, e.g. Mercator's projection, and you will remember how Greenland appears enormously exaggerated in size. Now those who adhered to the flat-earth theory must hold that the flat map gives the true size of Greenland. How then would they explain that travellers in that country reported that the distances were much shorter ? They would, I suppose, invent a theory that a demon resided in that country who helped travellers on their way, making the journeys appear much shorter than they " really " were. No doubt the scientists would preserve their self-respect by using some Græco-Latin polysyllable instead of the word " demon," but that must not disguise from us the fact that they " really " were appealing to a *deus ex machina*.

The name demon is rather suitable, however, because he has the impish characteristic that we cannot pin him down to any particular locality. We might equally well start our flat map with its centre in Greenland ; then it would be found that journeys there were quite normal, and that the activities of the demon were disturbing travellers in Europe. We now recognise that the true explanation is that the earth's surface is curved ; and the demoniacal complications appeared because we were forcing the earth's surface into an inappropriate flat frame which distorts the simplicity of things.

What has happened in the case of the earth has happened also in the case of the world, and a similar revolution of thought is needed. An observer, say at the centre of the earth, finds that there is a frame of space and time—a flat or Euclidean frame—in which he can locate things happening in his neighbourhood without distorting their natural simplicity. There is no gravitation, no tendency of bodies to fall, so long as the observer confines his observations to his immediate neighbourhood. He extends this frame of space and time to greater distances, and ultimately to the earth's surface, where he encounters the phenomenon of falling apples. This new phenomenon must be accounted for, so he invents a *deus ex machina* which he calls gravitation, to whose

activities the disturbance is attributed. But we have seen that we may just as well start with the falling apple. It has a flat frame of space and time into which phenomena in its neighbourhood fit without distortion; and from its point of view bodies near it do not undergo any acceleration. But when it extends this frame farther afield, the simplicity is lost; and it, too, has to postulate the demon force of gravitation existing in distant parts, and for example causing undisturbed objects at the centre of the earth to fall towards it.

As we change from one observer to another—from one flat space-time to another—so we have to change the region of activity of this demon. Is not the solution apparent? The demon is simply the complication which arises when we force the world into a flat Euclidean space time frame into which it does not fit without distortion. It does not fit the frame, because *it is not a Euclidean or flat world*. Admit a curvature of the world and the mysterious disturbance disappears. Einstein has exorcised the demon.

SCIENTIFIC BOOKS

Inorganic Chemistry. By T. MARTIN LOWRY, D.Sc., F.R.S. (Macmillan & Co., 28*s*.)

This is an excellent book, undeniably the best of its kind in English. The worst that one may say about it is of its cost, which is distressingly expensive. But its purchase is worth while. It covers the ground of inorganic chemistry which lies between that traversed by the elementary books like *Alexander Smith* and the larger treatises like *Roscoe*. For the first time in a general textbook we have the newer subjects such as atomic number, isotopes, crystal structure, and Langmuir's theory of valency not only explained but given their proper place in the scheme. Very wisely Dr. Lowry has obtained the assistance of specialists in several subjects in which he does not profess a first-hand knowledge: in the sections on isotopes, on pigments, on photography, on glass, and in the chapter on radio-activity. So that, although the field covered is broad, there is a sureness of touch nearly everywhere which the conscientious compiler with his system of card-indexes has never attained.

A happy feature of this book is the important place given to metals and their alloys. The average textbook of chemistry stresses the non-metals too much, and one of the reasons why students do not like chemistry at first is because they are tired of hearing about hydrogen and ozone. Dr. Lowry gives the metals their due. He deals with them from the physical-chemical standpoint. Another obviously good feature is the excellence of the diagrams, especially the beautiful photographs of crystals which have been well chosen and well reproduced.

This book is recommended to the serious student who wants an informed and comprehensive account of the whole subject in one volume, something more than that contained in the elementary books studied at school or in the first two years at college, and less than that in the larger treatises or monographs. It is nevertheless a book for the general reader also. Some textbook writers forget their readers and write to placate imagined critics. This book is written for its readers; a fact evident not only in the pains the author has taken to have his information accurate and up-to-date, but in the clear and concise manner in which it is set forth.

The A B C of Wireless. A Popular Explanation. By PERCY W. HARRIS. (The Wireless Press, 6*d*.)

A plain straightforward attempt by the editor of *Conquest* to tell the man in the street the elements of wireless. Well written and printed, with a few excellent photographs.

Within the Atom. A popular view of Electrons and Quanta. By JOHN MILLS. (George Routledge and Sons, 6*s*.)

The author knows what he is writing about, but is mistaken in believing he is appealing to the general reader. He tells us he wishes to make himself understood by those "who have no previous knowledge of electricity, mechanics, or chemistry," and then proceeds to pour out such a vast store of information of a highly technical kind that one would need to have an F.R.S. at one's elbow as one reads. What he does do is to describe briefly and, in the main, accurately the latest work on the structure of the atom and related problems. But only those who have already studied these matters in the usual textbooks will appreciate what he is describing. We think it is doubtful if such a complicated thing as the inside of an atom can be explained in popular terms. A writer would require to be exceedingly clever to write such a description; it would be an unselfish piece of work. And one thing the writer must do is to consider his intended readers, and not simply, consciously or unconsciously, as so many do, write to please himself or to keep himself in the good estimation of his friends. This, we think, is what Mr. Mills has done. And so he has fallen between two stools; for the weaker brethren can digest little of this book and the strong will like their meat fresher.

Life and the Laws of Thermodynamics. By SIR W. M. BAYLISS, M.A., D.Sc., F.R.S. (H. Milford, 1*s*.)

Sir William Bayliss' "Boyle Lecture" to the Junior Scientific Club of Oxford University is hardly up to the usual level of these lectures. It is evident that the lecturer has been pressed to avoid technicalities and to keep simple, and we think he has taken the injunctions to heart too literally. A. S. R.

Man the Animal. By W. M. SMALLWOOD, Ph.D. (New York: The Macmillan Company, 12*s*.)

One of the most difficult tasks of the man of science is to write a good popular book on his subject. The present volume is a gallant attempt. It contains some admirable photographs, bringing home very vividly the early steps in embryology, and the appearance of cells and tissues under the microscope, and treats of a variety of interesting topics. It has two ambitious chapters on methods of learning in man and animals. But it is somewhat too didactic, and often lays down natural "laws"

with the moral earnestness of a Moses or a Hammurabi.

It has many small faults of detail, and some large ones of perspective; but it is an interesting little book, which most educated people could read with profit, especially if they could read it critically. J. S. H.

NOTES FROM CONTEMPORARIES

In recent years controversies have raged as to the extent of ancient Egyptian influence on the literature of the Bible. The debt of the Biblical writers to Egypt seems to be put beyond doubt in a scholarly and brilliant article by Dr. A. B. Mace in vol. ix of the *Annals of Archæology and Anthropology*, published by the University of Liverpool (6s.). Dr. Mace divides his evidence into three parts: (1) Influences on the *form* of poetry; (2) Influences on the general character of the literature; (3) Influences on religious doctrine. In the first part he points out the well-known quality of Hebrew poetry which "depends to a certain extent on rhythm, but more particularly on a parallelism of words or thought between the different parts of the verse." This is a very unusual form of poetry, "yet we find it fully developed in Egypt in 2000 B.C., and distinct traces of it a thousand years before that." To take only one of the examples quoted of this type of parallelism:

> O Lord, how manifold are Thy works!
> In wisdom hast Thou made them all.
> *Psalm* civ. 24.
>
> How manifold are Thy works!
> They are hidden from before us.
> *Hymn to Aton.*

In the second part of the evidence we are given profuse examples of Egyptian influence on the subject-matter of Hebrew lyrical poetry—the Psalms, the Song of Solomon, etc.; on the Didactic books—Job, Proverbs, Ecclesiastes; and on the Prophetic Books. The Book of Job, for instance, in so far as the first portion of the tale is concerned, has an interesting forerunner in the Dialogue of a Misanthrope, written probably at least fifteen hundred years earlier. "In the Misanthrope we get the picture of a man once prosperous brought to ruin, deserted by friends and relatives, and stricken with disease. His name has become 'a stench in the nostrils' of man. In this plight he holds an argument with his soul as to whether it is not better to die than to live. The conclusion he comes to is that life under present conditions is impossible, that death will be a happy release, and that after death there will at least be justice done, and that the innocent will not suffer with the guilty." Of Egypt's religious influence Dr. Mace says: "Help for the poor, justice for the oppressed, belief in righteousness for its own sake, personal relationship with God—all these were known and practised in Egypt before they were thought of in any other country."

Many interesting photographs and details of the latest and largest addition to the transatlantic liners, in fact the largest vessel in the world, are given in the July number of the *Scientific American* (New York: Munn and Co., 35 cents). The *Majestic* has a tonnage of 56,000, nearly 10,000 tons above that of the *Olympic*, a length of 956 feet, a maximum speed of 24½ knots (oil-fired boilers have been installed), and accommodation for 4,100 passengers. We often hear the term "floating hotels" applied to modern liners, but the *Majestic* would be a super-hotel, if she were run up on land. Her main dining-room seats 652 persons, and her main lounge, which is fitted with beautiful oak panelling and carving and is not supported by any interior columns, is 76 feet long and 54 feet broad. The second-class accommodation is as good as the first-class on most liners, and the third-class has its lounge, smoking room, and dining saloon. The swimming-bath is modelled on the lines of the ancient baths in Pompeii, and is finished in marble and rich mosaics. The vessel has seven and a half acres of decks, and a walk through all the corridors and public rooms would take well over two hours; in fact one would have to cover a distance of nine miles.

Sir J. George Scott contributes an article, full of colour, on *Burma* to the July–August issue of *The Blue Peter* (1s.), a magazine of sea-travel to be found on most of the liners going out East. The current idea about Burma is that it is "a land of dismal swamps." This is far from the case, as even the railway traveller will realise. "From the flat rice-fields he passes into the dense teak forests of Pyinmana, goes on through the undulating 'dry zone,' where prickly plants and gnarled trees show how hot it can be in the dry season . . . ; then on to the irrigated country close under the hills of the Shan plateau. And everywhere there are pagodas and monasteries; the pagodas perched on heights or embowered in mango and acacia trees; some washed snow-white; some glinting bright with gold-leaf, and the monasteries with multiple roofs and gables carved in teak with the artistic skill for which the Burman is famous."

Those of our readers who heard the gypsy-songs of M. Balieff's *Chauve-Souris* Company in London last year will find much to interest them in Mr. Gilliat-Smith's article on "Russian Gypsy Singers" in the current *Journal of the Gypsy Lore Society* (printed privately by T. & A. Constable, Ltd.).

Mr. Gilliat-Smith, who is something of a modern George Borrow, has lately been studying the songs of gypsy refugees from Russia in Sofia. "The songs of the St. Petersburg gypsies," he says, "consist of Russian 'Gypsy Romances,' mostly in the Russian language and in the Russian style. Like all such songs they depend for their effect largely on their method of delivery. The gay ones are wild, furious, licentious. The sad ones, which far outnumber the former, are sung with infinite pathos, little half-sobs frequently catching at the voice, which is utterly untutored, so much so that the singer often uses up her store of breath on the forte portion, with the result that the pianissimo parts tend to become nearly an inaudible whisper. Many of these songs now exist in good gramophone records, notably those of Varja Pánina, the famous Moscow singer, who died some years ago, and though quite an old woman, went on singing to the end, enjoying greater and greater popu-

larity. Besides these, there are the unprinted gypsy songs, almost entirely in Romani, said to be of great age (*ǵaratuné giljá*), sung to wilder music than the Russian romances, and said to be brought straight from the tents, from the Nomad Gypsies (*felditkone romender*). These latter continually send recruits to the town singers, whose dialect is not markedly different from theirs. All these songs are harmonised, there being always a first and a second voice. Each verse consists of from two to four lines, and between each verse the voices sing, again in harmony, the refrain, to which there are no words, and which consists of tra-ra-ri-ras, etc., *ad libitum*. The guitars accompany both the song and the refrain, but do not strum alone between the verses, as they do in Spain."

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY AND ARCHÆOLOGY

The Rural Community. By LLEWELLYN MACGARR, M.A. (The Macmillan Company, 8*s*.)

Historical Sites in Palestine. By LT.-COM. V. L. TRUMPER, R.N.R., M.R.A.S. (Marshall Bros., 3*s*. 6*d*.)

LITERATURE

Macbeth, King Lear and Contemporary History. By LILIAN WINSTANLEY, M.A. (Cambridge University Press, 15*s*.)

MISCELLANEOUS

Cold Light on Spiritualistic Phenomena. By HARRY PRICE, F.R.N.S. (Kegan Paul, Trench, Trübner & Co., Ltd., 6*d*.)

The Conquest of the New Zealand Alps. By SAMUEL TURNER, F.R.G.S. Illustrated. (T. Fisher-Unwin, Ltd., 21*s*.)

PHILOSOPHY AND PSYCHOLOGY

The Poetic Mind. By PROF. F. C. PRESCOTT. (The Macmillan Company, 9*s*.)

Fundamental Conceptions of Psycho-analysis. By A. A. BRILL, Ph.B., M.D. (George Allen & Unwin, Ltd., 12*s*. 6*d*.)

Outwitting Our Nerves. A Primer of Psychotherapy. By JOSEPHINE A. JACKSON, M.D., and HELEN M. SALISBURY. (Kegan Paul, Trench, Trübner & Co., Ltd., 7*s*. 6*d*.)

Juvenile Delinquency. By HENRY H. GODDARD. (Kegan Paul, Trench, Trübner & Co., Ltd., 3*s*. 6*d*.)

The Philosophy of Humanism. By VISCOUNT HALDANE. (John Murray, 12*s*.)

SCIENCE

The British Association for the Advancement of Science: A Retrospect, 1831–1921. By O. J. R. HOWARTH, O.B.E., M.A. (The British Association, Burlington House, Piccadilly, W.1, 7*s*. 6*d*.)

An Introduction to Electrodynamics. By PROF. LEIGH PAGE, Ph.D. (Ginn & Company, 10*s*.)

Modern Microscopy. By M. I. CROSS and MARTIN J. COLE. Fifth Edition, revised and rearranged by Herbert F. Angus. (Baillière, Tindall & Cox, 10*s*. 6*d*.)

The "Green Ray" or "Green Flash" (Rayon Vert) at Rising and Setting of the Sun. By PROF. DR. M. E. MULDER. (T. Fisher Unwin, Ltd., 6*s*.)

The Psychic Life of Insects. By PROF. E. L. BOUVIER. Translated by L. O. Howard, M.D., Ph.D. (T. Fisher Unwin, Ltd., 8*s*. 6*d*.)

The Tutorial Chemistry. Part II. Metals and Physical Chemistry. By G. H. BARLEY, D.Sc., Ph.D. (University Tutorial Press, 6*s*. 6*d*.)

The fourth edition of a book deservedly popular among students preparing for pass examinations in the University of London. The best *cheap* book on general and inorganic chemistry in print.

Metallurgy of Iron and Steel. Based mainly on the work of Sir Robert Hadfield, F.R.S. Edited by R. E. NEALE, B.Sc. (Sir Isaac Pitman & Sons, Ltd., 2*s*. 6*d*.)

A compilation made by the editor of Pitman's Technical Primers. It is too short and too general for the student, but excellent for the general reader.

Handbook of Commercial Geography. By GEO. G. CHISHOLM, M.A., B.Sc. Ninth edition. (Longmans, Green & Co., 25*s*.)

The eighth edition of this important work was published in March 1911. The new edition describes Europe and the world as far as facts about them can be ascertained in the present year, and is the result of a drastic revision of the old. The book gains in value with each new edition. To praise a work which has been in existence for thirty-three years would be superfluous.

Journal of Scientific Instruments. Preliminary Number. May 1922. (The Institute of Physics, 2*s*. 6*d*.)

The first number of this periodical is well edited and produced, appears to be strongly backed, and shows great promise. Its future will depend, we are told, upon the numbers willing to subscribe. No journal at the present time deals adequately with the subject-matter of this one—scientific instruments. It should therefore have a wide appeal and be of great service. With the backing of the recently founded Institute of Physics and with the co-operation of the National Physical Laboratory it should occupy a permanent position in the stream of indispensable scientific literature.

Notes on Quantitative Analysis. Supplement. By H. J. H. FENTON, Sc.D., F.R.S. (Cambridge University Press, 3*s*. 6*d*.)

A supplement to Dr. Fenton's well-known *Notes on Quantitative Analysis*, giving the chief reactions and properties of the rarer elements, and of a considerable number of organic and inorganic compounds which were not described in that book. Chemical students will find this book useful both in their practical and theoretical work.

Correspondence

THE PROBLEM OF PERSONALITY

To the Editor of DISCOVERY

SIR,

The correspondence in your columns on the subject of Personality and its basis or bases adds weight to your original suggestion that there was need for classification and collation of the different views on the subject.

Might I endeavour in the fewest possible words to give the views of a biologist? In face of the short space at my disposal, I shall be forced to make what appear dogmatic assertions: may I make it clear at the outset that the assertions represent simply my own opinions (although I also think that many, perhaps most, biologists would agree with me), and that I could adduce evidence if space were available?

Modern biology, then, is coming to think of the organism as a unitary psycho-physical mechanism; both "mental" and "material" characters are properties of the living substance of which it is composed. Its view is therefore neither idealist nor materialist, but, if you like, monist. It is impossible to alter one function without altering others indirectly; thus the mental reacts upon the physical, and vice versa.

In considering the problem of personality, we have to distinguish at the very outset between *inherited* factors and *environmental* factors. Both of these may influence the personality. A good example is given, e.g., by worry. Worrying tends to a certain type of so-called neurasthenia. The fact of worrying, however, and its intensity, depend (*a*) upon the tangible "worries" which confront a man, but also (*b*) upon the degree of his hereditary predisposition to worry. Circumstances which one man will confront with equanimity may lead to a nervous breakdown in another. Or, again, phthisis depends (*a*) on an external factor, the tubercle bacillus, and (*b*) on a factor which is chiefly hereditary—the degree of resistance to infection. Practically all of us harbour tubercle bacilli; but in only a comparatively small percentage do they give rise to disease.

Personality in a similar way is partly dependent upon external, environmental factors—social conditions, infection, treatment when young, worry, etc. etc. These factors, however, undoubtedly play a relatively small part in forming personality compared with those which are hereditarily determined.

Here we have to think, so to speak, on several different levels. In the first place, there can be no doubt that the characters of body and mind alike are mainly determined by the hereditary factors or genes contained in the fertilised ovum and revealed to us by the work of Mendel, Bateson, Correns, Morgan, etc. During embryonic development, however, these give rise, *inter alia*, to the ductless glands, and thenceforth these are entrusted with a very important share in the regulation of growth, chemical processes, nervous reactions, etc. etc. There can be no doubt that these glands, once formed, do exert pronounced effects upon the quality and types of the personality. Dr. Berman has been hasty in many of his generalisations, as well as neglectful of everything but the ductless gland system; but he has done good work in promoting discussion, and in making the public realise that personality is only a name for a balance of elements in the organism, much of which is determined by the ductless glands. Numerous other chemical processes also occur which must react on the glands and brain and so affect personality.

Finally, we have the brain and the rest of the nervous system, whose development is also determined by hereditary factors in the germ-plasm. There is again no doubt but that inherited variations in general brain-type, and correspondingly in mind-type, do occur. For instance, some nervous systems appear to be more easily excitable than others; or, again, some minds make associations more readily, others less readily—this difference is probably at the bottom of the difference between the "introvert" and "extrovert" types of the modern psychologist. Many other general tendencies and special aptitudes of mind (e.g. music) are undoubtedly hereditary.

Finally, once the brain and mind have been formed in development, they may react upon the rest of the nervous system and through it upon the ductless glands.

We may sum up our conclusions in diagrammatic form, thus:

Factors affecting personality
- A. Inherited
  - (1) Hereditary factors (genes) in germ-plasm. These give rise to:
  - (2*a*) Chemical processes of ductless glands.
  - (2*b*) Other chemical processes within the body.
  - (2*c*) Nervous system and brain, with associated mind (psycho-neural mechanism).

  This last may react upon (2*a*) and (2*b*).
- B. Environmental.

It is of course for certain purposes possible to think of the organism on a purely mechanical, or a purely chemical, or a purely mental basis. Any such view, however, is bound to be partial.

Mechanical, chemical, electrical, mental processes all occur within the organism; the organism can only be considered as a whole; and in considering any complex property of the organism as a whole, such as personality, we cannot neglect any of these various factors. The problem is extremely complex, but does not present any *logical* difficulty if looked at from the monistic angle I have indicated.

Yours, etc.,

J. S. HUXLEY.

NEW COLLEGE, OXFORD.

June 6, 1922.

DISCOVERY

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Editorial Notes

The highest mountain in the world still remains undefeated. This is not for want of daring and endurance on the part of its attackers, or of highly efficient arrangements on the part of their supporters. Captain Bruce and Captain Finch got to a point 1,800 feet from the summit. This in itself was a great achievement. We mentioned a few of the difficulties that beset the climber of Everest's final 6,000 feet in these notes last April. In our November number that well-known explorer, Dr. Rudmose Brown, will explain these difficulties in fuller detail, and will give a general account of the work of the expedition. Meanwhile we must take up the cudgels once more against those people who continue to insist that these expeditions are mere "suicide clubs."

*   *   *   *   *

This year they have rather strong ground for defending their ideas on the subject, in that several members of the carrying party perished in the return from the second assault. At once they were able to turn round and say, "There you are. We told you that a disaster would befall this sort of undertaking. Do you really consider this loss of life worth while in an attempt to attain to what is an entirely useless object?" Superficially their objections seem well merited. The most useful gains to knowledge resulting from these two expeditions have been brought back not from the higher altitudes of Everest, but from its lower slopes and surrounding country, which have been mapped out by surveyors, and explored by botanists and geologists. It is not very likely that the men who reach the summit will find a new type of rock, or observe a new star. No; the work that is most apparently useful is done below, and it could be done without anyone ascending beyond 20,000 feet at the most.

*   *   *   *   *

All this is exceedingly rational, a sound piece of "common sense." But the queer characteristic of "common-sense" notions and "common-sense" persons is that they rarely achieve anything important in life. But, to extend these arguments, why play tennis or cricket? You may beat your opponents, but, even if you do, you have made no material gain and, incidentally, you have run the risk of being hit over the head with a racket up at the net, or of losing the sight of an eye from a fast ball. What the whole matter comes to is this: "Never take any risks unless you are pretty certain that they may bring you some material gain." Admittedly, this is a crude presentation of these people's point of view, but we will look at it from both a deeper and broader angle. Months ago we maintained in our [1]columns that "every conquest of our surroundings is a step forward in the upward march of humanity. It may lead to great developments. Of course, it may not. . . . . All the discoveries of modern science are based on the patient work of those who have laboured to discover the secrets of Nature without caring twopence whether or not they were of 'practical value.'"

*   *   *   *   *

The growth of civilisation has gradually and largely freed us from the necessity of a continuous effort to preserve our physical welfare, and has allowed the instincts and energy, hitherto devoted to these

[1] Discovery. Editorial Notes, Vol. II., No. 16.

materialistic pursuits, to develop in other directions. Men have unfortunately grown accustomed to think of civilisation as standing for the watchword of "Efficiency." This is true enough, but it is not the whole truth. We venture to think that no one who believes in evolution, in the idea that some gradual process is being worked out amongst mankind, as in every branch and portion of life and matter in the universe, can think of civilisation merely in these terms. The highest result of civilisation seems to us to lie in the fact that it is lifting mankind from the position merely of maintaining life on this particular planet into a position of using that life for higher ends, such as the study of itself and the universe which surrounds it, or of the development of the faculty of appreciating beauty. The knowledge that astronomers have acquired about the peculiarities of certain stars will probably not increase our efficiency or our material comfort; the development of the decoration of pottery did not make eating or drinking easier; and the only material uses of music and poetry, of which one can think, lie in their capacity for soothing troubled nerves, though they could not even be so used except in the case of persons with some considerable æsthetic faculty.

* * * * *

In general we may say that civilisation has resulted in an endeavour on the part of mankind to expand outwards, often with a risk to individual members of the race. All this seems a far cry from Mount Everest. But if we view the attempts to conquer Everest, or the conquest of the North and South Poles, in the light of the preceding considerations, we cannot but see in them a few of the more obvious proofs of that collective urge, that *élan vital*, which is ever driving us forward. Whither we are being driven we cannot humanly say. The urge is there, and to trust to it is, we think, the only possible and the only satisfactory course.

* * * * *

This month, from the 6th to the 13th, the British Association will visit Hull for its annual meeting. The President, Sir Charles Sherington, is by an uncommon coincidence also President of the Royal Society. This has happened only twice before: in 1848 to the Marquess of Northampton, and in 1893 to Lord Lister. The programme, like all British Association programmes, is exceedingly interesting. The social interest of Hull as a great fishing centre will receive prominent attention in a series of sectional discussions dealing with the North Sea. Thus there will be joint discussions on the geological history of the North Sea basin, on biology and fisheries of the North Sea, on land reclamation on the East Coast, and on tides with special reference to the North Sea. Historians tell us that it is probable that the herring came into the North Sea from the Baltic and elsewhere in comparatively recent times. We hope that, as a consequence of this considerable discussion on them and their surroundings, they will not take it into their heads to quit.

* * * * *

The subjects of the evening discourses, which rank in importance next after the presidential address, were mentioned in a review which appeared in this journal last month. This year there will be four Citizens Lectures on the lines of those started by Huxley and Tyndall in the "Sixties." Dr. E. H. Griffith, F.R.S., will speak on "The Conservation and Dissipation of Energy"; Sir Westcott Abell on the "Story of the Ship"; Dr. Smith Woodward on the "Ancestors of Man"; and Professor Coleman, of Toronto, on "Labrador." There will also be special lectures for children by Professor H. H. Turner on "The Telescope and what it tells us," by Professor J. Arthur Thomson on "Creatures of the Sea," and by Mr. F. Debenham, the explorer, on "The Antarctic." With sectional addresses and sectional discussions for specialists, evening lectures and joint discussions for those who are learned but not necessarily specialists, lectures for citizens, and lectures for children, in addition to social meetings, visits, excursions and the like, it is plain that all classes who care anything at all about science and who betake themselves to Hull, are being very amply catered for. In addition, a special effort is being made this year to attract the younger generation of students, and the generosity of a former president of the Association has enabled a certain number of the younger graduates of our different universities and university colleges to be entertained as guests during the meeting.

* * * * *

The mathematicians, economists, and agriculturists are holding a discussion on economic periodicity, and will in particular discuss Sir Wm. Beveridge's theory that a bad time in trade will be coming in a few years; the chemists and botanists will discuss recent research on photo-synthesis, especially the action of light in effecting the synthesis of bodies like starch and sugar from very simple compounds; the zoologists and the botanists will discuss the present position of Darwinism; the agriculturists and the economists, the possibility of increasing the food supply of Great Britain; and the psychologists and the educationists, the relation of psycho-analysis to the School. These are some of the leading joint-discussions.

* * * * *

On looking over the subjects chosen by the sectional presidents for their addresses we notice two features

clearly—one, what an extraordinarily broad field the activities of the Association now cover; and the other, how wide is the application of science to the problems of present-day life. No less than eight of these thirteen addresses refer to man and problems of his every-day life; and, of the other five, three alone may be properly accounted academic. This trend towards the application of science to life is a remarkable one. It was not ever thus. Long ago science and her exponents did not worry about this application, and the legend about the professor at one of our ancient universities who, after a laborious life devoted to very intricate research, thanked God he had never done anything that was or would be of use to anybody, although a legend only, puts this fact in an easily remembered form. But to-day the temper is different. "I do not believe in science for the sake of science," said Professor Karl Pearson recently, "but only in its application to man. Thought and learning are of little value unless they are translated into action." As we have already indicated in these notes, we do not agree with this point of view, and we think that the moderate man will prefer a position somewhere between the two extremes.

* * * * *

We wonder what the men who composed the British Association seventy years ago, when it paid a former visit to Hull, would think of the views of those composing it to-day. They would be astonished by many of these, and aghast at some; astonished chiefly at views which have come from the widening of science, aghast chiefly at those resulting from the application of science to man. Thus they would be astonished at Principal Irvine's address on research problems in the sugar groups, or at Sir Richard Gregory's paper on educational and social science, still more at Mr. Peake's address on the study of man. But what would they think of the presidential address to the Geography section, "Human Geography: First Principles and some Applications"; or of that to the Agriculture section, "The proper position of the Landowner in relation to the Agricultural Industry"; or of that to the Economics section, "Equal pay to men and women for equal work"? What is human geography, they would like to know? And what is this nonsense about men sharing rights with masters, or about men and women being paid equally? Professor Hudson Beare's address to the Engineering section on "Railway problems in Australia," could not have been delivered in 1852 unless perhaps the professor was some kind of Jules Verne person. For Australia had no railway problems then; she had no railways. We have travelled a great deal along many roads since 1852.

Impressions of Greenland's Plant Life

By A. C. Seward, Sc.D., F.R.S., Pres. G.S.

Master of Downing College and Professor of Botany in the University of Cambridge

Last summer it was my privilege to spend three months in West Greenland (lat. 69° N.—71° N.) collecting fossil and living plants and rocks. Mr. R. E. Holttum, of St. John's College, Cambridge, accompanied me as Research Assistant; in the course of two motor-boat journeys of about 600 miles we visited several localities on Disko Island and the Nugssuak peninsula to the north of Disko Island, also Upernivik Island, Hare Island, and other places. Three weeks were spent at the Danish Arctic Station at Godhavn, Disko Island, where we received invaluable assistance from Mr. Morten Porsild, the Director of the Station, one of whose sons was our companion on the motor-boat.

A visit to Greenland in the summer affords a very incomplete idea of a country which is usually associated in one's mind with its winter aspect when, except in the more southern districts, the kayak is replaced by the sledge and all communication with the outer world is suspended. The Greenlander's kayak, a long, narrow, canoe-like boat, was aptly described by the late Sir Clements Markham as "the most perfect application of art and ingenuity to the pursuit of necessaries of life within the Arctic Circle." The isolation of Greenland has compensations. A Danish friend who passes the winter there told me that he watches the last ship leave in September with a sense of relief; it means at least six months of peace and quiet. A few brief descriptions of typical scenes may serve to dispel the popular fallacy that even in the summer this Arctic land offers few attractions as a place of residence. John Davis in the latter part of the sixteenth century described Greenland as a land of desolation, and added: "The irksome noise of the ice and the loathsome view of the shore bred strange conceits among us." Shelley's lines:

> "From the most gloomy glens
> Of Greenland's sunless clime,"

though applicable to certain localities in the winter, do scant justice to Greenland in summer.

The abundance of flowers makes an unexpected impression upon a visitor imbued with the idea of a country practically buried under a mass of ice of unknown depth, and of a long winter when the sea is frozen and even the coastal regions are covered with snow. One effect of Arctic conditions is to limit the production of foliage shoots and often to induce an abnormal development of subterranean stems and roots and a prolific crop of flowers. The amount of energy expended in the production of roots becomes

apparent if an attempt is made to dig up intact a fairly large prostrate Willow. The rocky ground is generally covered with a thin layer of soil and roots are unable to grow far in a vertical direction. In some places permanently frozen ground is met with at about two feet below the surface, while in other situations there may be at least two yards of unfrozen earth or sand in the summer. The root of one Willow we dug up was traced for at least twelve yards, growing horizontally not many inches underground. Size is a misleading criterion of age; the wood of a Willow stem barely an inch in diameter may show as many as 100 attenuated annual rings. In the districts we visited Willows, including the British species, *Salix herbacea* (the smallest tree in the British Isles) and a few other species, with many hybrids, and the dwarf Birch are the only trees. The tallest examples growing in sheltered places or against the sides of rocks reach a height of two to three feet; for the most part they lie prone on

Fig. 1.—PART OF A DELTA WITH COTTON GRASS AND OTHER PLANTS.
[R. E. Holttum, *photo.*

the ground with no main stem but spreading and often twisted shoots in which the annual increase in length is very small. In South Greenland, on the other hand, trees are more abundant and much higher; in rare instances they reach a height of about eighteen feet. In addition to Willows and Birches there are Junipers, Alders, and the American Sorb (*Sorbus americana*).

Landing on a beach where glacial streams have built up a fan-shaped delta sloping seawards in a graceful curve from the mouth of a ravine cut by successive spring floods through the rocks of the raised plateau, one finds stretches of muddy flats and boggy ground covered with the waving white plumes of the Cotton grass and many other familiar plants (Fig. 1); on the drier ground are bright reddish-purple patches of a handsome Willowherb closely allied to our common British species, and clumps of bright Poppies and darker and more brilliant Dandelions. In both wet and dry situations the bright green feathery stems of the common Horsetail flourish in quantity. The hill sides are often clothed with a thick carpet of heath-forming vegetation mixed with stunted Willows; the leaves of some of the Willows are covered with a silvery down forming an attractive background to the dark red catkins. Trailing branches of the Dwarf Birch, parti-coloured tangles of Lichens, Mosses in different shades of green, and creeping or erect Club Mosses are characteristic features. Among the common heath plants are the Bilberry, which in the latter part of the summer provides an abundance of fruits dusted with a blue-grey bloom, the Crowberry, a Rhododendron resembling the Alpine Rose, a species of Ledum—sometimes called Labrador tea—a plant of American origin with dense and fragrant clusters of star-like flowers, Phyllodoce, characteristic of high northern latitudes, and found also in the Pyrenees but not on the Swiss Alps, with its purple bells recalling those of our Heaths, and an abundance of the beautiful white flowers of Diapensia, a genus with a wide distribution from Spitsbergen through Grinnel Land to Eastern Canada and the United States and Japan, two species of a widely spread American and Siberian genus Cassiope, the commonest of which, *Cassiope tetragonia*, has small crowded leaves like green overlapping scales grasping the slender stems in four regular geometrical rows with here and there a white bell pendulous on a delicate stalk. One of the most abundant and attractive plants is *Pyrola grandiflora*, a species unknown in Britain but represented in our flora by its near relative the Winter Green; from a rosette of glossy dark brown leaves the flowering shoot stands erect bearing a series of wide-open flowers with pinkish white petals. The yellow and pale pink flowers of Pedicularis (the genus which includes the Lousewort), crowded on stout stems with rich brown leaves, add to the variety of colour. A species of Dryas, *Dryas integrifolia*, very similar to the British Alpine species *Dryas octopetala*, is exceedingly common. The pure white flowers and slender grey-green stems of the Alpine Cerastium (the Alpine Mouse-eared Chickweed), the viviparous Polygonum, its tall spikes with terminal flowers overtopping most of its neighbours, groups of blue Harebells, and on the sandy beaches the darker sky-blue flowers of Mertensia, several different kinds of Saxifrage, species with shining white flowers on long stalks and the more compact cushions of *Saxifraga oppositifolia* with a rich display of purple-blue flowers; species of Ranunculus and Potentilla and an attractive little Draba allied to the white Vernal Whitlow grass with yellow and white flowers; clumps of yellow Dandelions and Arnicas; these with many other less showy plants, in which brown is the dominant shade, all have a share in the general scheme of colour.

Many of the Greenland flowers are familiar British or European species; others come from the New World; botanically as well as geologically Greenland has many features in common with both the eastern and western hemisphere. It is a noteworthy fact that among the flowering plants recorded from the country as a whole, about four hundred, only one or two are peculiar to Greenland. On rocky slopes, often tucked away in crevices, the cushions of the Moss Campion (*Silene acaulis*), anchored by a strong tap root like an elongated rat's tail burrowing far into the covering of earth, represent a well-known architectural type in Alpine and Arctic countries.

In the neighbourhood of Godhavn, especially in the exceptionally favourable locality known as Englishman's Harbour, so called because an English Captain mistook it for the main harbour and wrecked his ship there, the abundance of southern types is a striking feature. The sheltered bay faces south, and has the added advantage given by the warm springs, reminiscent of the days of volcanic activity in this part of Greenland, which issue along the irregular boundary between the old granitic foundation rocks and the much more modern superstructure of basalt and beds of ash. Here can be seen in profusion, in company with a host of other plants, yard-high stems of Archangelica clasped by the large and handsome leaves and bearing candelabra-like umbels of small yellow-green flowers, a plant familiar to us from its use as a sweetmeat and highly prized by the Eskimo as an article of food; also the large and almost circular bright green leaves, four inches or more in breadth, and inconspicuous flowers of a northern species closely related to our Lady's Mantel; the tall flowering spikes of the Orchid Habenaria (Fig. 2), akin to the Frog Orchis of Britain; also smaller plants of the Tway Blade Orchis, and the delicate mauve tasselled flowers of an Alpine Meadow Rue. The Butterwort (Pinguicula) was found in full bloom in the boggy ground. A few Ferns mix their graceful fronds with the foliage of the flowering plants, and other, generally smaller ferns, pass their life hanging on the vertical faces or in the fissures of rocks. The occurrence at Englishman's Harbour and at other localities on Disko Island of plants characteristic of the more southern parts of Greenland is consistent with an Eskimo legend, according to which Disko Island once lay much farther south. In its original home the island was a hindrance to navigation, and an Eskimo Sorcerer towed it behind his kayak to its present situation.

Despite the shortness of the season and the hard conditions inseparable from an Arctic climate, the vegetation competes successfully in the show it makes with that of warmer countries, and is in some respects superior. How, it may be asked, does the vegetation of Greenland compare with that of the tropics? Sunlight, air, and water are everywhere the driving forces of the living plant. In Arctic lands cold and dry winds and winter snow set limits to the upward growth of shoots and compel them to hug the ground and to exercise a strict economy in the production of vertical stems. A large proportion of the energy available is expended upon the formation of reproductive organs. Tropical conditions induce length of stem and leaves on a lavish scale, the formation of dense jungles in which the competing trees make every effort to obtain a place in the sun. By comparison with the variegated carpet of flowers that

FIG. 2.—ORCHIDS, POLYGONUM, DANDELIONS, FERNS, ETC. ENGLISHMAN'S HARBOUR.
[R. E. HOLTTUM, *photo.*

brightens an Arctic landscape, the ground in a tropical forest is intensely gloomy; the flowering shoots of climbers are festooned over the branches of crowded trees often blossoming far above the reach of man or even beyond his vision, while the smaller plants pass their life attached to the sunlit boughs of supporting trees in the topmost region of the jungle. Arctic conditions demand a concentration of effort, and the result is a "rush of flowers" when once the winter is passed. Timely preparation is

made during the growing season which ensures a prompt response to the first call of spring; buds are ready by the end of summer; in the winter they find shelter under the snow or below a covering of dead leaves. It is an interesting fact that annuals are very rare in Greenland, only four or five flowering plants complete their life-cycle in one season. In the Swiss Alps the percentage of annuals falls as higher altitudes are reached.

While it is true that many of the Greenland plants exhibit a characteristic and peculiar habit of growth and certain external characters and structural features in their foliage and stems that are usually considered to be adaptations to rigorous climatic conditions, others are in no visible respect different from plants that flourish in a warmer and much more favourable environment. The power to endure hardship probably resides in some quality of constitution, something that is fundamental in the composition of their "physical basis of life," the living protoplasm.

The high northern distribution and the abundance of flowering plants in the Arctic regions are in striking contrast to their absence in corresponding latitudes in the southern hemisphere. The North Pole is surrounded by the Polar Sea bounded by a ring of circumpolar lands; the South Pole is situated on a vast continent separated from the nearest land masses by the turbulent Southern Ocean with scattered archipelagoes and solitary islands, some of which are of comparatively recent origin, while others may be vestiges of submerged connecting bridges. Not a single flowering plant has been discovered within the Antarctic Circle. The most southerly representative of the flowering plants, over four hundred of which occur in Greenland, is a grass (*Deschampia antarctica*) which was found in the sub-antarctic region, and reaches its southern limit at latitude 62° S., a position corresponding to that of the Faroe Islands and the south of Finland in the northern hemisphere.

The fringe of Greenland where the snow and ice, like winter clothes, are discarded as soon as the freezing-point is passed, becomes in the more favoured situations a paradise of flowers not equal in brilliance to Alpine meadows at their best, but characterised by a harmony of colour in keeping with the sombre grandeur of the setting. The barrenness of wind-swept slopes, that on the melting of the snow are scarred by destroying streams leaving in their track patches of withered shoots pressed against the ground and dead dishevelled Willows anchored by bared roots, like cables dragged taut by the strain of rushing water (Fig. 3), intensifies that impression of sharp contrasts that a Greenland landscape produces. Charles Lamb's contemptuous description of seashore vegetation in "The Old Margate Hoy" essay is applicable to some parts of an Arctic land:—"I hate those scrubbed shoots, thrusting out their starved foliage from between the horrid fissures of dusty innutritious rocks, which the amateur calls verdure, to the edge of the sea." But in the scrubbed shoots of the Willows and the Dwarf Birch, with their profusion of catkins doomed by the force of circumstances to lead a prostrate life on bare rock, on the faces of cliffs, or creeping among a miniature undergrowth of Moss, Lichen, and other plants, there is a beauty that arrests attention; and in the late summer, when the green leaves have turned to light orange or brilliant red, and the Willow catkins are covered with open capsules releasing the white fluffy seeds, the ground becomes a mosaic of colour that it would be difficult to match in many more favoured lands.

The influence of Lichens as factors concerned with colour production in Nature is well illustrated in many parts of Greenland. At the small Settlement of

Fig. 3.—WILLOWS ON SANDY SLOPE WITH EXPOSED ROOTS. [R. E. Holttum, *photo*.

Niakornat the huts of the natives are built close to the beach or perched on ledges on the higher ground. Seen from a distance the massive and partially rounded though rugged boulders and hills of volcanic breccia—a rock composed of angular pieces of a fine-grained and in part glassy lava embedded in a matrix of volcanic ash—produce a particularly gloomy impression by the contrast of their dark shoulders to the lighter hills near them; but on a nearer view the dark surfaces are seen to be almost covered with splashes of a vermilion Lichen. It is not improbable that in the menacing headlands that guard the harbour of Niakornat and partially encircle the Settlement we have the relics of a vast accumulated mass of ash and splintered rocks ejected from some old volcano in the immediate neighbourhood. The peculiar construction of Lichens renders them less dependent than other plants upon the nature of the substratum on which they grow. As films of dull black they dapple the grey surfaces of granitic rocks while other species produce a harmony of orange, yellow, and grey. On stony ground among bosses of

protruding rock, and mixed with prostrate or tufted shrubs of the heath vegetation, large cushions of grey Lichens that when dry crumble to the touch, the flat deeply lobed surfaces of a bright yellow species, and the clumps of erect branches of stouter forms sometimes tipped with small scarlet balls, give light and brightness to the duller background.

The vegetation of Greenland is intensely interesting to the botanist, not only because of the richness of the flora, but from the point of view of its past history, the relation of the vegetation of to-day to that which preceded the Glacial period, and the routes by which the pioneers of the present plant population arrived. There is a certain emotional influence produced by the heath-covered hill sides and swampy lowlands, by the scattered colonies of more brilliant flowers on the drier rock-strewn regions of this treeless land for the perception of which no knowledge of Natural Science is needed, and even the layman's sense of wonder is stirred when he considers what this display signifies as a triumph of the forces of life over adverse physical conditions.

NOTE.—For a more technical and more complete account of the vegetation of West Greenland, and for references to literature, see R. E. Holttum, *The Journal of Ecology*, Vol. X., No. 1, May, 1922.

Honey that Drove Men Mad

By W. R. Halliday, B.A., B.Litt.

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IN the Near East honey is still used as the chief constituent of most of the somewhat cloying sweetmeats which are dear to Turkish palates. In the ancient world it was not merely a luxury but a necessity, filling, as it did, the place of sugar in modern life. It was consequently an important article of commerce and bee-farming was a serious branch of profitable husbandry. That is the reason why Vergil, for instance, devoted one of his four *Georgics* to bees. His choice was not merely due to the desire to draw the moral of the analogy between human society and that of the hive, which has been a popular topic with poets and preachers in all ages.

In Illyria mead was manufactured from honey. But like beer, which was also known to the Greeks and Romans,[1] mead never became popular in the essentially wine-drinking countries of the Mediterranean, though honey was used for softening and sweetening wine. In mythology (I do not know of an historical instance) there is an example of smearing a criminal with honey and exposing him to the consequent torture of flies; and the ancient Greek analogue to *The Mistletoe Bough* tells how Glaucus, the son of the King of Crete, when chasing a mouse fell into a large jar of honey and was lost. He was, however, more fortunate than the bride in the English song, for when he disappeared there happened to be at hand a famous "wise man" from overseas, Polyidos of Argos. He was called in, discovered the boy's fate, and was then informed that he must take steps to restore him to life, and that he would be shut up in the tomb with the dead body until he was successful. While thus immured Polyidos killed a snake, whereupon its consort brought a leaf of a herb in its mouth, laid it on the wound and restored it to life. The seer watched this proceeding with interest, procured a leaf of the magic herb, and brought the boy to life again. The king, however, was not yet satisfied and refused to let the prophet leave his dominions until he had taught Glaucus his magical lore. This Polyidos was obliged to do, but, as at length he left the shore of Crete, he bade his pupil spit into his mouth. Glaucus did so, and the magical knowledge which he had acquired left him and returned to its imparter.[1]

It has been thought that the story of Glaucus falling into the honey-pot may have some connection with early burial custom. Both Babylonians and Persians used beeswax as a preservative for corpses.[2] It may have been from the East that the Greeks learned this use of it. Special importance was attached at Sparta to the funeral rites of their kings, and if the body of a king for any reason could not be brought to Sparta, the rites were carried out with an effigy of the corpse. At least, in one historical instance, that of Agesilaus, in the middle of the fourth century B.C., the body of a king who died abroad was embalmed in beeswax and so brought home for burial.

From the earliest times honey, milk and wine formed the triple offering to the dead, and although the worship of "heroes" (*i.e.*, the spirits of dead men of legendary or historical importance), seems to have become a prominent feature of Greek religion only in post-Homeric times, the author of the eleventh book

[1] The attitude of Greeks and Romans towards beer finds its expression in the well-known epigram of Julian the Apostate. "Who and whence art thou, Dionysus? For, by the true Bacchus, I know thee not; I know only the son of Zeus. He smells of nectar, but thou of billy-goat. Did the Celts for lack of grapes make thee out of corn?" Anth. Pal. VI., 368 in *The Greek Anthology* translated by W. R. Paton (Loeb Classical Library) III., p. 201.

[1] The story is made up of folktale elements. There are classical variants of the snakes and the healing herb, *e.g.*, the story of Tylo, Pliny, *Natural History*, XXV., 5 and the tale told of Alexander the Great and Ptolemy, Cicero, *de div.*, II., 66, 13. References to variants will be found in Bolte and Polivka, *Anmerkungen zu den Kinder und Hausmärchen der Brüder Grimm* (Leipzig, 1913), I., pp. 128-129. For the way in which Polyidos deprived Glaucus of the magical knowledge which he had acquired see *ibid.* p. 133.

[2] Herodotus, I., 140 and 198.

of the *Odyssey*, which describes Odysseus' visit to the nether world, had clearly visited an oracular shrine of a hero. His description of the ritual with its triple libation of honey mixed with milk, sweet wine and water,[1] exactly corresponds with what is known to have been the rule in such ceremonies in historical times. Thus, for example, Iphigenia performs the funeral rite :—

> O Spirit, thou unknown
> Who bearest on dark wings
> My brother, my one, my own,
> I bear drink-offerings
> And the cup that bringeth ease
> Flowing through Earth's deep breast;
> Milk of the mountain kine,
> The hallowed gleam of wine,
> The toil of murmuring bees;
> By these shall the dead have rest.[2]

The living made their cakes and sweetmeats of honey and the varieties produced in different localities were distinguished by the connoisseur. The honey of Attica was already famous in the time of Solon (594 B.C.) and throughout antiquity it maintained a special reputation. Its excellence was attributed in part to the thyme which grew upon Mt. Hymettus, and attempts were even made to produce the same honey elsewhere by transplanting Hymettan thyme. It was thought, too, that the method of the Athenian beekeepers, who took the honey without smoking out the bees, in this way contributed to the purity of its flavour.

Honey, in fact, was eaten in all parts of the ancient world, and the peculiarities of the various kinds were well-known. If, therefore, the properties of the honey of a particular district excited surprise as something quite exceptional, we shall probably be right in assuming that it was peculiar to its particular part of the area known to the ancient world. Various kinds of honey were known which were unpleasant to the taste or deleterious in their effects. There was, for example, a Mauretanian honey which was unwholesome, and the Sardinian, thanks to the proverbial bitterness of the local variety of *apiastrum*,[3] a kind of wild parsley, possessed a bitter after-taste. But the honey produced in the south-east corner of the Black Sea, in the district which lies between Trebizond and Erzerum, stands quite by itself. The honey of Heracleia Pontica further to the west was in certain seasons deleterious, but the symptoms produced in the victim, who rolled upon the ground in an agonised sensation of extreme heat, seem to have differed from those caused by the honey of Trebizond. Colchis, further to the north, round the coast of the

[1] Homer, *Odyssey*, XI., 27. Butcher and Lang are mistaken in translating μελικρήτῳ "mead."

[2] Euripides, *Iphigenia in Tauris*, 156, translated by Gilbert Murray.

[3] Vergil, *Eclogue*, VII., 41.

Black Sea, has also fallen under suspicion of producing "maddening" honey. Tournefort quotes some second-hand information to that effect, which I suspect, however, of being inexact. Strabo knew that Colchian honey was bitter, and Evliyá Effendi warned people against eating it, but for a different reason.[1] So far as my acquaintance with the works of classical authors and of more recent travellers extends, the "maddening" honey, as it was called, is restricted to the Trebizond-Erzerum area.

Its properties were first made known to the Greek world through the involuntary experiment of Xenophon's Ten Thousand. After the death of the Pretender to the Persian throne, by whom they had been engaged, they had fought their adventurous way from the heart of Mesopotamia through unexplored country and savage peoples to the sea. They had almost reached Trebizond when the adventure of the honey occurred. Those who ate of it were affected according to the quantity consumed. The mildest symptoms were those of intoxication; those who had eaten a considerable quantity were like madmen, and those who had eaten largely became insensible. None of these died, but recovered consciousness in almost exactly 24 hours, though it was two or three days before they were themselves again.[2]

This maddening honey was naturally discussed in antiquity, and the cause of its properties was attributed to the nature of plants in the district from which the bees collected nectar. It puzzled Pliny that the character of the honey both at Trebizond and at Heracleia varied in different years, and the latter, it was noticed, was peculiarly liable to be poisonous when the spring was abnormally wet.

Grote, who accuses *Azalea Pontica* of responsibilty, rightly rejected the scepticism of a German named Koch, who, because he did not himself meet with poisonous honey in Pontus, thought that Xenophon's men must have eaten honey which had gone bad with keeping.[3] The ancient authors too are confirmed by the experience of a Turkish traveller in the seventeenth century, who had not read Xenophon. At the fortress of Hassan, in the province of Erzerum. Evliyá remarks, "bread and honey are rather to be suspected, for I myself, poor Evliyá, having eaten

[1] Strabo, XI., 2, 17, c. 498, Von Hammer, *The Travels of Evilyà Efendi*, II., p. 56. "These Abaza people have a strange mode of burying their Begs: they put the body into a wooden coffin, which they nail on to the branches of some high tree and make a hole in the coffin near the head, that the Beg, as they say, may look up to Heaven: bees enter the coffin and make honey, entirely wrapping the body up in it; when the season comes they open the coffin, take the honey and sell it: much caution, therefore, is required to be used in purchasing the honey of the Abazas."

[2] Xenophon, *Anabasis*, IV., viii., 20 foll. Translation in Dakyns, *The Works of Xenophon*.

[3] Grote, *History of Greece*, IX., p. 155.

some honey in the commander's house, became in half-an-hour so giddy that I thought of throwing myself down from the castle."[1] The French botanist and traveller Tournefort, in the eighteenth century, was of course familiar with the classics, and discusses the relevant passages in Xenophon, Pliny and Dioscorides. He attributes the origin of the poisoned honey to two different species of rhododendron, and evidently in the case of one of them local popular belief was with him; for when he intended to present a bouquet of its flowers to the pasha, in whose suite he was travelling, he was informed that their perfume caused headaches and was deleterious to the brain.[2]

My friend and colleague, Professor McLean Thompson, has been kind enough to give me some information which, although perhaps familiar to botanists, is evidently unknown to most readers and to the commentators on Xenophon; other persons, who are as ignorant as myself in such matters, may also find it interesting. Nothing, he tells me, can be found in the flowering records which can be used as evidence against any of the species of plants, which are quoted by the various authorities, to prove that they are naturally poisonous, nor is anything known of the Black Sea littoral which provides a basis for the idea that climate determined the poisonous nature of the honey. There are, in fact, no grounds for supposing that there is anything poisonous in the honey itself provided that it is collected normally by a nectar collecting insect. "But honey is almost invariably a lost product, produced in excess at a point in the flower where food materials should be used in forming floral parts. The latter fail to develop, the food materials are unused, and are exuded on what are in a sense the graves of the aborted parts. With this almost invariably there goes the development of succulent deformed mounds of tissue, replacing the perverted parts, and in these parts there is abnormal physiology and frequently the accumulation of by-products in which toxins abound. Now I can testify that in the cases you mention surface collecting of nectar is the rule, and this involves no risk of poisoning the nectar. But in seasons, when the competition for nectar pollen is intense, many insect types adopt a biting habit, piercing the tissues of many plants of different type, in search of short-cuts to food supply, while other types fail to develop this new habit. I have never known the nectar disc of Heracleum to be pierced and the corolla alone of Azalea is pierced and does not contain poison. Nevertheless, I have known many insects not drunk but completely stupified after a period of flower biting while collecting nectar. From this they recover after periods of from 8 to 24 hours. The inference is that in seasons when the biting habit is common, honey may be poisoned frequently by the toxins of plants which have been bitten. Recently (last year) I knew of so-called poisoned honey in Liége in a season when the biting habit was very common and on asking a beekeeper on the point, he said that in 1893, a year also when the biting habit was common, poisoned honey was known."

This explanation, it will be noticed, solves Pliny's problem, and confirms the accuracy of his observation that the honey was poisonous in some seasons and not in others.

[1] Von Hammer, *Op. cit.*, II., p. 119.

[2] Tournefort, *Relation d'un Voyage du Levant* (Paris, 1717), II., pp. 228 foll.

Galileo, the Roman Inquisition, and Modern Italian Philosophy

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A PLEASING trait in Italian life is the perennial interest Italian citizens take in the spiritual, as well as the patriotic, history of their country. The wealth of literature which this preoccupation with the things of the mind brings to light is remarkable. No community, however small, however remote from centres of population, but which has its patient students. Monographs of this nature abound, often produced at the cost of the renunciation of the more material agreements of life. As in the citizen, so in the State. The new Italy, limited as she is in financial resources, reflects this care for the concerns of the mind. She publishes the works of her thinkers and her artists in monumental national editions, and Royal Commissions have published Mazzini's, Da Vinci's, and Galileo's works. The last, in twenty stately tomes, together with a supplementary volume of documents relating to Galileo's trial at Rome edited by the director of the national edition—documents long buried in the recesses of the Holy Office and in the secret archives of the Vatican[1]—have enabled Professor Gentile to include a collection of Galilean *Frammenti e lettere* in the publications of the *Biblioteca di Classici italiani*.[2] By the aid of these documents and Gentile's admirable notes and comments it is possible to review the story as told in the calm order of the legal procedure.

If we may imagine the symbolic man-in-the-street to be set before a paper, "Write what you know of Galileo," he would probably (if he answered at all)

[1] *Galileo e l'Inquisizione. Documenti.* A. Favaro. Florence.

[2] R. Giusti. Leghorn.

reply that Galileo was an Italian astronomer who taught that the earth was round and not flat; that it circled round the sun instead of being stationary; and that when tortured by the Roman Inquisition and made to recant he muttered between his teeth, "*Eppur si muove.*" Marks would be low, for the good Galileo never was put to the torture, and he never said "*Eppur si muove.*" Nor did the mediæval astronomers teach the earth was flat. I imagine there are but few readers of Dante's *Vita Nuova* nowadays who are not made to sit up when they discover that to understand the reference to Beatrice's age in the very first paragraph, a knowledge of the precession of the equinoxes is necessary—an astronomical phenomenon known to every mediæval student, although regarded from a geocentric standpoint. If there is one thing more than another which distinguishes the modern from the mediæval student, it is his ignorance of practical astronomy—of the apparent motions of the heavenly bodies. If anyone would form a conception of the astronomical knowledge of the mediæval scholar, let him get a sight of the perpetual almanack compiled by Profacius (Machir Ben Tibbon)[1] of the University of Montpellier, in the latter half of the thirteenth century, from which the courses of the moon and planets and their eclipses might be foretold at any given date from 1300 onward. As early as the fourth century, tables and rules were extant by which the days and hours of eclipses were accurately calculated. And if one remembers that such calculations were rendered much more complicated and difficult by being based on a geocentric theory of the universe, one's respect for the precision and range of early astronomy will be tenfold. Pre-Galilean astronomy from the days of Hipparchus to Ptolemy and Alphraganus had been elaborated and perfected during the progress of eighteen centuries; it adequately explained the apparent phenomena and served all practical purposes of civil life—an astronomy rendered almost sacred to the mediæval mind by the infallible authority of Aristotle—an astronomy which Sir Thomas Browne regarded as a proof of God's wisdom, and which Bacon refused to reject in favour of the Galilean theory. Besides its practical uses there was another reason why the mediæval mind was absorbed in the contemplation of the heavenly bodies and their wandering paths, and why the astrologer sought to fathom the sweet influences of the Pleiades—their supposed infallible influence on mortal life and destiny.

How much longer geocentric astronomy would have persisted if a Dutch spectacle-maker's apprentice had not, while playing with some lenses, discovered that by placing two of them at intervals distant objects became nearer, none can tell; but to a young professor of mathematics at Padua the toy became a key to a startling new reading of the heavens.

"In August 1609," writes the Venetian diarist Priuli, "I climbed the campanile of St. Mark with the excellent Galileo and Signor Contarini, to see the marvels of the said Galileo's new tube. Closing one eye and looking through the other each of us saw distinctly Fusina and Chioggia, and even Conegliano, and folk entering and leaving the church at Murano, with many other details truly marvellous to behold." Marvellous and indeed revolutionary! Imagine what would be the feelings of our scientists of to-day if a new discovery were to render obsolete all modern physical science, vitiate our heliocentric astronomy, make all our text-books and professors back numbers: some conception may then be formed of the feelings of the mathematicians of Galileo's time. There is nothing absolute in what is termed scientific truth. Our system is true so long as it satisfactorily explains phenomena as we know them, and that is precisely what the geocentric system did in pre-Copernican days, and did it more satisfactorily than Galileo's new theory. Galileo was a born controversialist, and employed with masterly skill that grave and eloquent irony which Carducci says so splendidly closes the great literature of the sixteenth century. This and his mordant sarcasm were ill calculated to win over opponents. He thus trounces a learned classical senior who quoted Suidas in proof of a theory on the nature of heat—Suidas who stated that the Babylonians used to cook eggs by whirling them quickly in a sling. "Of course, if I am told I *must* believe this I will, but I can't help saying this much. If we don't succeed in producing an effect that was successfully produced in earlier times some element of success must be lacking, and this element must be vital. Now we have eggs and slings and stout fellows to swing them. Yet the eggs don't cook; on the contrary, if they were hot the swinging would more quickly cool them. Therefore, since all that is lacking to us is that we are not Babylonians, it follows that the fact of being Babylonians is the effective cause of the eggs cooking, and not the attrition of the air—which is what I set out to prove."[1]

Contrary to what is generally believed, Galileo was first brought up, not against the Church, but against the mathematicians and Aristotelians—Aristotle who, as students of Dante will know, was authoritative in mediæval schools. If Aristotle said a thing, like *John Bull*, it was so. "I was one day," says Galileo, "at a physician's house at Venice who was giving a lesson in anatomy. Having dissected and traced the nervous system to its origin in the brain, and its extension through the spinal cord and its ramifications through the human body, a sceptical Aristotelian present said, 'You have demonstrated this so clearly to my senses,

[1] Edited and published at Florence in 1908.

[1] *Frammenti*, p. 66.

that if it were not for a text in Aristotle which says the nerves have their origin in the heart I should be forced to admit you were right.' "

Unhappily, Galileo, or his disciples, failed to take the advice of a Roman friend and keep outside the sacristy. All things are lawful, but all things are not expedient, and a letter to Father Castelli, a Benedictine mathematician in 1615, admirable in its distinction between science and the Bible, which passed in many copies from hand to hand, began the trouble. The letter was denounced in February, 1615, by a Dominican rival to Rome, and added theological to mathematical odium. Moreover, another Dominican friar, a month later, deposed on oath to the Holy Office, that preaching against Copernicus one day in the cathedral at Florence, on the text, "Sun, stand thou still upon Gibeon," he had displeased certain petulant disciples of Galileo, known as *Galileisti*, who went about promulgating heretical doctrine. On November 13 a Spanish friar deposed to the local Inquisitor that he too had heard the *Galileisti* say the earth moved round the sun.

On February 24, 1616, eleven Inquisitors met at Rome and decided certain propositions on sun spots were absurd as philosophical propositions, against theological truth, or at least errors in faith, and Cardinal Bellarmine was charged to admonish the said Galileo the mathematician to renounce the opinion that the earth moved round the sun, and wholly to abstain from teaching or defending or treating of it under pain of imprisonment. Galileo, then at Rome, promised obedience, and was received kindly and sympathetically by Pope Paul V., and spent three-quarters of an hour strolling about with the Holy Father, who assured him of his esteem and confidence in his integrity. The year before, Cardinal Bellarmine had written worldly-wise advice to a Carmelite *Galileista*, " You and Galileo would do well to speak *ex suppositione* and not absolutely. If you say supposing the sun stands still and the earth circles round it, the apparent motions of the heavenly bodies *may* be better explained than by the theory of eccentrics, cycles, and epicycles, it is well said; no danger will be incurred. But if you assert that actually the sun *is* the centre of the universe, that is dangerous, and serves not only to irritate the scholastic philosophers, but to injure the Holy Catholic Faith."

Ardent possessors of a new truth are seldom amenable to worldly wisdom, and Galileo continued to explain phenomena on the Copernican theory.

As late as 1630 Galileo counted on the publication at Rome of the famous *Dialogo sopra i due massimi Sistemi del Mondo*, which had received the *Imprimatur*, and in that year he had a long audience with his friend, Cardinal Barberini, now Pope Urban VIII., who enjoined him to preface the work with a statement that the subject was treated as an hypothesis. Urban also advised him to end the Dialogue with an argument which he himself regarded as conclusive against the Copernican theory. After long and tiresome negotiations at Rome, the book was at length published at Florence in 1632—preface and conclusion as enjoined. But—most assuredly the interlocutor who defended the geocentric theory might have done better. Worse than all, the conclusion, the clinching demonstration of the falsity of the Copernican doctrine, was placed in the mouth of Simplicio (Simple), who throughout opposes the most futile arguments which are triumphantly disposed of in Galileo's caustic and facetious manner. Urban was furious. He declared that the Dialogue was more pernicious than the writings of Calvin or Luther. Jesuits and theologians were in ecstasies. They hounded on to the scent, and on September 23, 1632, the congregation of the Holy Office cited Galileo de Galileis, a Florentine, to Rome, and forbade the sale of the book.

Galileo opposed passive resistance, trusting to Grand Ducal influence to change the venue of the trial to Florence, and the local Inquisitor, whose duty it was to send the defendant to Rome, had a most unhappy time. On October 2 Galileo protested he was *prontissimo* to go, and signed on the 9th a document to that effect, witnessed by six ecclesiastics. On November 20 he was ready to set forth, but pleaded advanced age and sickness. A month's grace was given. A month passed and the Inquisitor reports to Rome that Galileo de Galileis was in bed though still *prontissimo*; but times were troublous. Three physicians testified that their patient suffered from an intermittent pulse, vertigo, hypochondriacal melancholy, insomnia, pains wandering about his body, severe hernia, and other troubles. Any slight external cause might imperil his life. An angry rescript from Rome followed. The Holy Office would tolerate these subterfuges no longer. They were sending a special medical commission to report, and if the said Galileo were in a fit condition, he must be brought to Rome, even if a prisoner in irons.

On January 8 the Father Inquisitor read the summons to the recalcitrant Galileo. This time he *was* resolved to obey *quanto prima*; he was *prontissimo* to set forth, and, in fact, after a journey of twenty-one days, did reach the Holy City. On the morrow of his arrival the Assessor of the Inquisition took him for a carriage drive, and with much kindness advised him as to his future conduct. It was an indication, he wrote, that the treatment in store for him was to be *molto mansueto e benigno*—very different from comminations of ropes, chains, and dungeons. During his examination he was received at the Holy Office with *dimostrazioni amorevoli*, assigned comfortable quarters with his body servant

in the handsome official apartments, and allowed much freedom of movement.

Subjected to many examinations, Galileo claimed he had not contravened the Bellarmine admonition of 1616. It was all so long ago. He might have been bidden not to teach the doctrine. He did not remember the phrase *nec docere quovis modo* (not to teach it in any way); it might have been used. He did not admit that he had taught the said opinion; he had confuted it and demonstrated the contrary. This he swore to and signed. On April 30, after close and continual reflection, it had come into his mind to read his book again and diligently to observe if by pure inadvertence something had escaped his pen by which a reader might argue a contravention of the orders of Holy Church. And so reading it as if it were a new work, and by another author, he must confess that in many passages the doctrine was treated in such wise that a reader, unacquainted with his intimate character, might have reason to form a conception that the arguments adduced on the false side (which his intention was to refute) were stated in such a way that their efficacy was potent rather to convince than to refute. His error was one of vanity and pure inadvertence.

After further reflection Galileo asked for another audience. For greater confirmation that he had neither held, nor did hold, as true the damnable opinion of the motion of the earth, he was prepared if time were given, to demonstrate this more clearly. The occasion was opportune since the interlocutors in the Dialogue had agreed to meet again for further discussion. In two or three days, with God's help, he would refute the arguments adduced in favour of the false and damnable opinion in the most effective way. In a further written defence the aged and weary scientist humbly appeals for clemency and kindness, and begs his judges to regard his ill-health and the exposure of his winter journey as ample castigation for his offences.

On June 21 another signed deposition assures his judges that for a long time he had remained indifferent to both opinions; both were disputable. Later, however, all ambiguity was at an end, and he had then held, as he did now hold, that Ptolemy's doctrine was *verissimo* and indubitable; to wit, the stability of the earth and the mobility of the sun. The Dialogue was written, not because he held Copernican views, but to benefit mankind. "I do not hold," concludes the harassed Galileo, "nor have I held this opinion after the order of the Holy Office to let it. As for the rest I am in your hands, do with me as you please." At a final examination he was enjoined to tell the whole truth, and reminded that there was the last resource of torture if he did not. "I am here to do obedience," was the answer. "I have not, as I have said, held this opinion since the decree." Nothing further could be had from him, says the report of the trial, and the sentence was drawn up. On June 22, 1633, in the presence of ten Inquisitors, in the Convent of the Dominican Friars at S. Maria sopra Minerva, the judgment of over a thousand words was read to the kneeling Galileo, who abjured and cursed the errors he was vehemently and justly suspected of. His sentence was, imprisonment during the Pope's pleasure and the obligation to recite weekly the Penitential Psalms.

From the time of his arrival at Rome up to the present, March 7, 1634, he writes to his friend Diodati, from his villa at Arcetri, "he had, thank God, enjoyed better health than for many years past." The first place of incarceration assigned to him was the Tuscan ambassador's beautiful palace and gardens (now the Villa Medici in possession of the French Academy of Fine Arts) on the Pincian, where he was treated affectionately as a son, both by the ambassador and his consort. He was then interned at the Archiepiscopal palace at Siena, where he experienced *inesplicabili eccessi di cortesia* by the prelate, his friend, whose *gentilissima conversazione* he enjoyed with great repose and satisfaction. Growing weary and desirous of change after five months' stay, he was permitted to return to his villa outside Florence, where he breathed the salubrious air of his native place, though forbidden to descend to the city. This to keep him away from the Ducal Court. But if he could not go to the Duke, the Duke could come to him, and for two hours conversed with extreme sweetness. Having suffered nothing in the two things that are esteemed above all others in this world—health and reputation—the injustice that envy and malice had plotted against him neither had troubled, nor would trouble him; absent friends must be content to know this much.

Moreover, at the Convent of S. Martino in Arcetri, the aged and darkening Galileo was in touch with his two daughters by a Paduan mistress, who by papal favour had been permitted to take the veil. The elder and beloved Sister Maria Celeste, *donna di esquisito ingegno*, whose horoscope he had cast, and who idolised her father, was a bright influence in Galileo's life, and her premature death a deep and abiding sorrow. Sweet Sister Maria Celeste, whose tender graceful letters have found a place in the annals of Italian literature, who took upon herself the burden of her father's penance to recite the seven penitential psalms once a week! Throughout the whole correspondence no word of torture, and the facsimiles of his signatures to the depositions, from first to last, show no variation.[1]

Shall we say Galileo lacked courage? That in contrast to the heroism of his predecessor, Giordano Bruno, the proto-martyr of Free Thought, Galileo

[1] *Galileo e l'Inquisizione*, pp. 82, 83, 84, 85, 102.

quailed before the rack and the stake? No. Galileo had steadfastly maintained that the spheres of Science and Faith were separate, that they never intersected, and that there was no need to measure one against the other. Galileo, says Professor Gentile, who certainly cannot be accused of any tenderness to the Roman Inquisition, was the first to recognise that, if ever and whenever the conflict came, science ought to bend as he bent in the cloister of the Minerva. He renounced because his truth was declared incompatible with the doctrines of the Church. The duty of the Church, said Galileo, was to teach men how to go to heaven; not how the heavens go. His position was, that there existed a twofold revelation of divine truth. One positive, absolute, supernatural: the other in continual, progressive formation. One the infallible source of truth and doctrine regarding belief and conduct; the other wholly independent, the domain of scientific research. One deposited in the sacred scriptures and directly inspired by God; the other the fruit of the human mind faithfully reading the book of nature. The importance of his defence of science against the attacks of religious tradition consists in the demonstration of the rights of free scientific research—science by his very definition wholly sundered from those cognitions which theology made dependent on revelation. It differed from theology (which in those days included ethics) in that it had no bearing on the essential aim of the spirit of man, or, as he put it, on the salvation of souls. It was the knowledge of nature conceived mechanically and determined according to quantitative relations, a naturalistic science. But, asks Gentile, does a purely naturalistic science exist?—a science which deals with a reality whose mode of being and operating is indifferent to the soul of man? It was impossible that the theologian of Galileo's time could grasp this absolute separation between the world envisaged by the man of science and that contemplated by the Church—the Church, Catholic and Protestant—concerned with the salvation of men's souls. In the vital question of the day, the Council of Trent, the Tübingen Faculty, the common consent of all the Fathers; all the commentators, Greek and Latin, the millennial traditions of all Christian saints and martyrs, were against Galileo—how could the whole of the Christian Church be indifferent to a revolutionary definition of the world, not merely regarded as the hypothesis of a mathematician, but as existing in *de facto* reality? A world no longer evolved in a scientist's brain, but that very actual state of being which man was a part of, and in which the theologian by divine imposition had laid upon him the awful, the solemn responsibility of guiding man to right moral conduct in this world and to eternal salvation in the world to come. Galileo's imperishable fame rests less on his eminence as a thinker than on his apostolate of the experimental method in natural science. He was a herald of free research, a deliverer of the human mind from the thraldom of Aristotle and the bonds of scholasticism. He saw for the first time that a science of nature might be constituted if it were rigorously separated from metaphysics and based on a direct cognition of facts—facts, not deduced by a process of abstract reasoning, but already before the senses and indecipherable in their intrinsic, essential existence and in their qualitative differences; knowable and measurable only in their quantitative proportions. This science was the result of the experience of the senses, the *esperienza sensata*, and not the product of philosophic ratiocination; a material reality to which those criteria are not referable wherewith man interprets the actions of man and his final destiny.

The value of such a pure science of nature, which the eighteenth and nineteenth centuries applied themselves to, will surely be challenged in our own and in later centuries when the human spirit shall again face, but under a far different aspect, that fundamental problem which Galileo was brought up against—the problem of harmonising naturalistic science, which regards neither the ends nor the needs of spiritual man, nor the laws proper to his spiritual life, with the science that derives from the intuition of man's spiritual need. For the science which men turned to in those centuries with such hope and trust, and which might suffice them when they were engaged in *re*forming minds, prone to a reactionary dogmatism, by a new noviciate—this science no longer satisfies men's minds in which there rises a vague home-sickness for one knows what not beliefs and promises of mysterious satisfactions; for those spiritual and moral needs, which science does not and cannot satisfy, because science is directed to other ends. The new age will therefore demonstrate its limitations.

Sex and its Determination—II

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(*Continued from the August Number, page* 199.)

We have seen in a previous article that the higher animals possess special or sex-chromosomes, two in one sex, one in the other, by whose agency sex is determined.

What must the precise action of this machinery be supposed to be? What, for instance, is its relation to the so-called secondary sexual characters, all those which, like the beard of man, the voice of the nightingale, the plumage of the pheasant, the sexual instincts of many animals, are different in the two

sexes, but not directly concerned with the reproductive organs? Here again, recent research has given us a definite answer. The factors necessary for the development of the characters of both sexes are present in all individuals of any of the higher animals, but normally only those which are proper to one sex actually develop. The presence of one or of two X's acts like a switch, which alters the condition in the developing embryo in such a way that in one case only the male characters can reveal themselves, in the other case the female characters. A female animal contains, locked within the chromosomes of her cells, the factors which in other circumstances could combine to build a male, the male contains, never expressed in reality, the constitution of a female. That this is so is shown definitely by the facts observed when two species are crossed. The males of different species of pheasants, for instance, differ from each other very much in plumage, while the females are all more or less drab and alike. If a female Reeves pheasant is crossed with a male of another race, the males among the hybrid offspring show many characters of the male Reeves pheasant,

Fig. 1.—A FEMINIZED MALE GUINEA PIG ACTING AS SUCKLING FOSTER-MOTHER TO A YOUNG SPECIMEN.
By permission of the Editor of the "Journal of the Royal Society of Arts." (After Steinach.)

although these characters must have been transmitted through the chromosomes of the mother, in whom they were invisible.

In insects, the simple presence of one or two X's in the cells of the body is enough to call forth the proper sex-characters; but in higher animals like birds and mammals, there is another link in the chain. This link is furnished by the reproductive organs. The sex-chromosome machinery acts as a switch which allows either male or female reproductive organs to develop in the embryo; but as soon as these are developed, they start producing a secretion or hormone which is necessary for the development of all other sexual characters. The most complete proof of this has been afforded by the extraordinary experiments of Steinach, Sand, Moore and others, who have removed the reproductive organs from young rats or guinea-pigs, and grafted into them reproductive organs taken from individuals of the opposite sex. The result has been a complete alteration in the animals' growth, ending in an almost complete assumption of the characters of the opposite sex. Male guinea-pigs whose reproductive organs have been removed and replaced by ovaries have even yielded milk and suckled young in the normal way (see Fig. 1), and show the sexual instincts proper to females. Such animals can, of course, not breed, since at the time of the operation, the internal organs associated with reproduction were already laid down, and only the subsequent growth of the animals was affected. Recently, however, ingenious experiments have been carried out by which developing hens' eggs were opened, and a small piece of reproductive organ from a fowl grafted on to the membrane surrounding the yoke. When the operation was successful, and the chick was of opposite sex to the reproductive organ grafted on to it, the whole development of its reproductive system was affected, and the chicks reached the stage of hatching in a condition intermediate between male and female, often nearly transformed into the opposite sex from that which they by rights should have been.

Very interesting results have also been obtained on adult birds. Here it is found that the ovary secretes some substance which prevents the development of male plumage. A capon, or any male bird with reproductive organs removed, shows no alteration of plumage. But a hen bird whose ovaries are taken out will at the next moult assume the plumage proper to the male. Further, there exist certain breeds of fowls, such as the Sebright bantam, in which the cocks are hen-feathered, and possess none of the special hackles and curved tail-feathers usually seen in cocks. This must be due to their possessing a secretion similar to that of an ordinary hen, for when their reproductive organs are removed, we find, paradoxical as it may seem, that they assume normal male plumage as the result! In insects, as indicated already, removal of the reproductive organs has no effect upon other sex characters.

We next come to certain strange abnormalities which throw considerable light upon our problem. Among insects, curious individuals are found from time to time in which some part of the body—usually a half or a quarter—is male in character, while the rest is female. These are known as *gynandromorphs*. In ants, very remarkable appearances may result. The male ant is winged, the worker female wingless; and thus a gynandromorph may be winged on one side only (see Fig. 2). In the fruit-fly, not only the sex and the secondary sexual characters, but also the sex-linked characters may be different on the two sides. It has recently been shown that the gynandromorphs we have mentioned are really female in constitution, but that at one of the early divisions of the egg, one of the X chromosomes lags behind and fails to get incor-

porated with the rest of the chromosomes. As a consequence, one of the resulting cells still has the proper complement of two X's, while the other has but one. The part with two X's becomes female; that with one, male. If the two X's were carrying

FIG. 2.—GYNANDROMORPHS OR SEX-MOSAICS.

(a) Pine moth (*Bupalus piniarius*); female on left, male on right.
(b) Ant (*Myrmica scabrinodis*); male on left, worker (sterile female) on right.

Reproduced from "The Determination of Sex," by Prof. L. Doncaster, F.R.S., by permission of the Editors of the "Journal of Genetics" and of the Cambridge University Press.

different sex-linked factors, sex-linked characters also could be different in the two regions of the body. In mammals, these sex-mosaics, as we may call them, do not occur, because the substances secreted by the reproductive organs pass into the circulation, and influence the sexual characters equally all over the body.

An even more remarkable abnormality is provided by what are called intersexes. The gipsy moth, that terrible forest plague, has a well-marked variety in Japan. When this is crossed with the European race, very curious results are obtained. When a Japanese male is crossed with a European female, 50 per cent. of the offspring are normal males, but the remainder are intermediate between male and female—so-called *intersexes*. When these are carefully examined, it is seen (by an examination of their hard parts, which, once formed, cannot he remoulded) that they have started their development as females, but ended it as males. They are females which suddenly, during their growth, have by some invisible but inexorable power been switched over to become of the opposite sex. All degrees of intersexuality are known, according to the races employed in the cross. The females may show only the faintest traces of maleness; may be equally male and female; may be preponderatingly male; or finally, in certain crosses, the change of sex may come so early that no trace of female characters appears, and the cross results in males alone. (See Fig. 3.)

Even though half of these all-male broods ought by rights to be females, yet all behave like normal males, and can mate and produce offspring. With these experiments, carried out over a long series of years by Professor Goldschmidt, of Berlin, we can at last be sure that it is possible for a complete and functional reversal of sex to take place.

When the cross is made the other way, with a Japanese female and a European male, the first generation is altogether normal. But in the second generation abnormal individuals again appear. This time, however, they are different from those first seen, and on analysis turn out to be intersexual males—*i.e.*, animals which have started as males and been forced to finish their development as females.

What is the explanation of these strange facts? It appears to lie, ultimately, in the different climates to which the different races are adapted. The Japanese races are adapted to grow more rapidly.

FIG. 3.—GIPSY MOTH (*Lymantria dispar*); SERIES OF INTERSEXUAL FEMALES.

Above, slight intersexuality; below, almost complete transformation to maleness.

By permission of the Editor of the "Journal of the Royal Society of Arts." (After Goldschmidt.)

The factor which produces maleness must lie in the sex (X) chromosome, which in moths is double in males, single in females. The factor producing femaleness we cannot yet locate so definitely; but it has been shown to be transmitted always and only through the mother; let us call it Q. Then all the

factors in the Japanese race are geared at a higher rate than those of the European race—are producing more of the characteristic sex-determining substances in a given time. Let us mark this difference by calling the sex-factors of the Japanese race $X+$ and $Q+$, those of the European race X^- and Q^-.

The cross Japanese male X European female will, as a minute's calculation will show, give female offspring with a "strong" male and a "weak" female factor—$X+$ combined with Q^-. Both male and female factors are producing their determining substances; in a normal female Q keeps ahead of X in its production; but here the "strong" $X+$ is producing too fast for the "weak" Q^-, and after a time catches it up. From this time forward, there is an excess of male-determining substances, and the animal must finish its growth as a male. The opposite result, when the production of female-determining substance gradually catches up and surpasses that of the male-determining, only seems to occur when a "strong" female factor, $Q+$ is combined with two "weak" male-producing factors, X^- X^-, and this can only come about in the second generation after a cross.

Similar reversals of sex are known in other animals, in shrimps, in frogs, and probably in hens. Indeed, it is quite possible that some sexually abnormal human beings are the victims of this sex-reversing power, and deserving, not of the opprobrium which they generally receive, but of pity for being in the grip of inexorable hereditary forces.

There is one curious consequence of intersexuality. If it goes so far as to lead to complete reversal, an animal will be produced with the appearance and functions of one sex, but the chromosome-constitution proper to the other. When such an animal comes to reproduce, this must lead to upsets of the sex-ratio in the next generation. In frogs, for instance, the sex chromosomes are probably XX in the female, XY in the male. When a female is converted into a functional male, she (or he, as we should now say) will still have the two X's. Therefore, when this animal mates with a normal female, which will also possess two X chromosomes, all the sperms and eggs alike will contain an X, and all the offspring will therefore be XX in constitution, and therefore females. Such an experiment has actually been carried out, and nothing but females obtained among the seven hundred odd offspring.

Space forbids us to enumerate more of these experiments, for, remarkable as some of them are—for instance, the fact that if a frog which has started to lay is stopped, and the rest of the eggs fertilised three or four days later, they will all give rise to males—we have as yet no explanation for them.

We must conclude with a short consideration of sex-determination in mammals and man. As we might expect, here too sex is normally determined at the moment of fertilisation. This is shown particularly well by the fact that whenever a single fertilised egg divides so as to give rise to two or more offspring, these are always of the same sex. This occurs as a normal event in the Texas Armadillo, as an exception in so-called "identical" twins in man. Other twins, and the members of the same litter in most animals, are equally likely to be of opposite sexes.

One of the most puzzling things so far discovered about sex is that the ratio of males to females is not always equal, and may vary from species to species, and at different seasons of the year. The fact that one sex possesses two, the other one X-chromosome should inevitably produce equal numbers of males and of females. Yet in man, for instance, the ratio of male to female births is about 107 to 100, and if we take into account the embryos which die before birth, the ratio of male to female conceptions is about 130 to 100. In many breeds of animals, again, the percentage of females is greater when the breeding season is at its height, the percentage of males greater whilst fewer young are being born. Recently it has been asserted by Siegel, on the basis of a good deal of evidence, that in man the percentage of males varies very considerably according to the time during the monthly period at which fertilisation or conception takes place. If this proves to be true, the power of controlling the sex of our children, of having boys or girls at will, will be to a considerable extent within our grasp. But in face of the fact that a great many other so-called specifics for controlling sex have turned out to be worthless, it is as well to be cautious. It has been maintained, for instance, that the right ovary produces eggs giving rise to boys, the left those which give rise to girls; or that the formation of male-producing and female-producing eggs alternate, first one sort and next time the other being given off. But it has been definitely shown that there is no foundation for these and many other similar statements.

There is, however, one understood fact which may prove to explain many difficulties. As we have already seen, male mammals have but one X chromosome. Their sperms therefore are of two kinds, one with, the other without an X. Where careful examination has been made, it is found that these two sorts of sperms can be distinguished by the microscope, those without an X being smaller. It is quite possible that these smaller sperms may be more delicate, or, in their long journey to reach the ovum within the female's body, may swim at a different rate from the larger. In any case, anything which affected the two classes of sperms differently would lead to a difference in the proportion of males and females produced.

The whole problem, as will readily be seen, is far indeed from solution. But here too we have made enormous strides in the last twenty years, and instead of the vague generalities which alone were possible before, can see the main lines along which the solution is to be sought.

We can see the characters and instincts of the two sexes as two divergent possibilities of human or animal constitution, both present potentially in all individuals of the race, and only waiting the right soil to develop. From this point of view it is easy to understand the fact that has struck so many observers of human nature, that feminine characters are often latent in men, masculine in women, and in particular circumstances may emerge, to their owner's surprise and sometimes confusion. The fact of intersexuality shows us that we may have to revise not only our moral judgments but our legal practice with regard to various abnormalities of sex in human beings, and the knowledge we have acquired of the sex-chromosomes is bound in the not-too-distant future to lead to a considerable measure of control over what until recently was one of the greatest mysteries of life.

(Concluded.)

The Determination of Sex. L. Doncaster. (Cambridge University Press, 12s.)

Inbreeding and Outbreeding. E. M. East and D. F. Jones. (Lippincott, 10s. 6d.)

The Descent of Man. C. Darwin. (John Murray, 9s.)

The Physical Basis of Heredity. T. H. Morgan. (Lippincott, 10s. 6d.)

The Study of English Place Names: A New Scheme

The study of English place-names has entered upon a new phase with the institution of a co-operative scheme for their investigation by Professor A. Mawer, of Liverpool University, under the ægis of the British Academy. The essential features in Professor Mawer's scheme are that an attempt will be made to cover the whole of England, and that the evidence of anthropology and archæology, of history and geography will be taken into account as well as the linguistic element. An account of the work of the Survey was given by Professor Mawer at a meeting of the Royal Anthropological Institute held on June 27th. He said that from the earliest times, the value of place-names as a possible source of historical knowledge had been recognised. Much early history had frankly been invented from them, and historians had speculated freely as to their meaning. More recently, scholars like Kemble had seen the possibilities latent in place-names; but until Professor Skeat first put Place-Name Study on its only secure basis, viz., the study of the early forms of the names, most of the work in this direction was only idle speculation. Conducted on scientific lines, Place-Name Study could do much to throw fresh light on the dark places in the history of our country and its civilisation, where we had no documentary evidence or only such as had long since been worn threadbare. Place-names and archæology were the only unworked sources of evidence still remaining open to us, and these studies should be conducted in close touch with one another. It had gradually come to be realised by workers in the field that we needed co-operative effort if ever we were to glean the true harvest of knowledge from place-names. The reasons for this were that (*i*) no safe inferences, either particular or general, can be drawn with reference to the names of any area except in the light of the full evidence for at least the whole of England; (*ii*) the range of interests, historical, linguistic, topographical, and archæological, concerned in the problems of place-names was so wide that they could not be dealt with adequately by any single scholar. Accordingly a scheme had been initiated under the patronage of the British Academy for a Survey of English Place-names, with a view not only to the interpretation of the individual names, but also to the drawing from them of all that wealth of historical and cultural lore which was latent in them. During the Survey's first six months of work a start has been made in several counties; many eminent scholars skilled in the various aspects of the work are giving active help, and close relationships have been established with the two Public Offices most immediately concerned in the matter, viz., the Ordnance Survey and the Public Record Office.

E. N. Fallaize.

New Light on a Neglected Century of British Sculpture

By Katharine A. Esdaile

English mediæval sculpture has never lacked admirers, but its post-Restoration successor is still curiously neglected, and writer after writer has been content to repeat the information contained in Walpole's *Anecdotes of Painting* without reference to

Walpole's sources, the Vertue MSS.,[1] once his own and now in the British Museum. Walpole himself was handicapped when dealing with these sculptors, since the most interesting volume was closed to him as a man of honour. "It is my wish," wrote Vertue on the title page of this book, "that this volume markt A. f. be at my death immediately ty'd about with string [and] seal'd up till the year 1772 or fifty years after my death." Unused, if not unopened, it

FIG. 1.—BUST OF WREN. BY EDWARD PIERCE.
Ashmolean Museum, Oxford. Photographed by kind permission of C. F. Bell, Esq., Department of Fine Arts, Ashmolean Museum.

has apparently remained, but its contents may be said to revolutionise our knowledge of such men as Rysbrack and Scheemaker; and it is these contents, together with other matter in the unsealed volumes, here presented in inverted commas, which form the basis of the present study.

[1] To George Vertue, engraver and antiquary (1684-1756) we owe almost all our biographical knowledge of seventeenth- and eighteenth-century artists, sculptors, and engravers. Walpole avowedly "offers to the public the labours of another person," and appends the life of Vertue to the *Anecdotes*; but in dealing with the sculptors he was handicapped by Vertue's wish of secrecy about much of his material; he was an old man when the later volumes appeared; and, his own chief interest being in painting, sculpture received less attention than was its due. Vertue's information on the subject was first systematically used by the present writer in a series of articles on the British Sculptors from Pierce to Chantrey, which have appeared in *The Architect* during 1921 and 1922, and are still uncompleted.

Fully to understand the sculpture of the period in question, we must know something of the opportunities that lay before the sculptors. When the Restoration came in 1660, the older generation of artists had almost disappeared during the twenty years of Civil War and Commonwealth rule; Le Sueur was dead; Fanelli had gone abroad; Stone was dead; though his sons, the younger Nicholas and John, were still at work. There were cogent reasons for the employment of new men. The Court had been and long remained in close touch with Versailles, where royal patronage of art and artists was already a tradition, and where the influence of Bernini and his followers was supreme; the nation overflowed with loyalty, and royal statues were an obvious method of demonstrating it; the Grand Tour was coming into vogue, and with it the habit of connoisseurship and the desire to bring the English mansion into line with the villas of France and Italy. Royal and noble patrons were ready to fill their palaces and gardens with sculpture ancient and modern—the former often needing restoration and therefore offering abundant employment to contemporary artists—and their parish churches with monuments to their dead ancestors and themselves. The middle classes, too, were getting richer, and had begun to live in a style which demanded greater luxury; the fashion for ornate tombs, moreover, had spread, and the results are visible on the walls of a thousand churches. Hence they, too, were ready to employ the sculptor's services, as well as to demonstrate their loyalty by putting up commemorative statues of the restored sovereign. From London to Lichfield the saturnine features were made familiar, and the Royal Exchange alone contained four statues of Charles II. Above all, the Great Fire offered an opportunity which no other event since the burning of Rome under Nero can parallel. St. Paul's, the Royal Exchange, and fifty-two churches, besides thousands of houses, the City Halls and the Monument itself, were built or rebuilt, apart from the fifty new churches commissioned in the reign of Anne; and as the sculptors of the day, like Stone in the last age, were often prepared to act as architects and monumental masons, the field thus opened was enormous.

The Revolution brought yet another change. William III., a delicate man, required country air; hence the palaces of Kensington and Hampton Court took the place of Whitehall in the reign of the earlier Stuarts as centres of artistic activity, and Cibber, Gibbons, and Pierce found fresh employment there under the all-supervising Wren. In the next reign came a great series of victories which led to the erection of monuments, as yet by individuals only, as

a means of expressing national emotion, the impulse given by Marlborough's wars lasting until Waterloo. A generation later the new interest in scholarship shown by constant new editions of the works of our older writers brought about the commemoration of Shakespeare, Milton, and Ben Jonson, who took their place at Westminster beside such contemporary idols as Cowley, Butler, and Congreve. The Abbey, in fact, was beginning to be looked upon as the epitome of our history, where literature, arms, politics, and music had equal rights; and it is surely a tribute to the spiritual insight of the eighteenth century that Westminster Abbey came to be regarded as the natural resting-place of the man of letters.

Fig. 2.—CIBBER'S "RAVING AND MELANCHOLY MADNESS."
Formerly over the gates of Bedlam, now in the Guildhall Museum.

With these conditions, these openings for employment, temporary and permanent, in our minds, we may briefly discuss the history and achievement of our century of English sculptors.

Edward Pierce, the son of a man of the same name, "Citizen and painter-stainer of London," was working under the Commonwealth and did not die till 1698. His known output is unfortunately small, but like that of Stone before him, and Cibber, Gibbons, and Bird after him, is both architectural and sculptural. His earliest works are the superb bust of Oliver Cromwell recently acquired by the Ashmolean Museum, and the model of the head of Milton—after 1654, since the poet is obviously blind—now at Christ's College, Cambridge, once in the possession of Vertue himself. As Pierce's father, originally an assistant of Vandyck, was employed at Whitehall, one can only conjecture that the son was somehow brought into contact with the Protector and his Foreign Secretary. Evidently, however, such employment was no bar to royal patronage, since Pierce not only contributed two statues to the Royal Exchange of 1667, but worked at Hampton Court, was the architect of the Dial at Seven Dials, and became the colleague both of Wren and Bird. For the former he carved the four dragons on the Monument; as "mason" he assisted to build St. Clement Danes; and above all he produced that glorious bust, now like the Cromwell at the Ashmolean Museum, of which Vertue wrote in his characteristically bad grammar and spelling, "In Bodleyan Gallery the Bust in Marble of Sir Christ^r Wren done by . . . Pierce the Same person as my moddel of Milton." This is the finest bust of purely Berninesque[1] type in

[1] Lorenzo Bernini (1598–1680), the founder of the late florid style of art and architecture known as Baroque, was incomparably the greatest architect and sculptor of his century, and his influence all over Europe was supreme until the days

England, and one of the triumphs of English art. On the rest of Pierce's work we cannot linger; it must suffice to say that his most florid monumental work is to be seen in the splendid monument to Sir William Maynard in the little church of Little Easton, Essex, and the drawing for a monument, never erected, to the Second Duke of Buckingham, Dryden's Zimri, of which the writer last year published a reproduction (*Architect*, September 2, 1921, p. 137).

The work of Pierce is typical of the course of English sculpture. Now it is decorative, now architectural; now he is employed on tombs, now on portrait busts and statues like that of Sir William Walworth at Fishmongers' Hall; but he must, like many of his fellows, have fallen into poverty in his old age, since all his pictures and models were sold by auction in 1695. He "lived and died," as Vertue tells us, "at his hse lowr end of Surrey street in the Strand, buried at St. Mary le Savoy."

Caius Gabriel Cibber (1630-1700), a Dane born in Flensborg, came to England in 1659, and is therefore the first of the new generation of foreign sculptors domesticated in England to whom the new conditions of English social life offered such wide and lasting opportunities. At once architect, decorator, sculptor, and monumental mason, he also typifies the age of Wren, and his work, as sculptor especially, ranks far higher than it is the fashion to allow. His most famous works, more familiar to an earlier generation than to this, are the Michael Angelesque statues of *Raving and Melancholy Madness*, figures typifying two forms of insanity, once over Bedlam Gates and now in the basement museum of the Guildhall, which Roubiliac, the greatest sculptor of the eighteenth century, would go out of his way to admire whenever he went to the city, and which were to furnish Pope with an admirable means of lashing his favourite butt the sculptor's son, Colley Cibber, laureate and dramatist, when he described in the *Dunciad* how

"O'er the Gates, by his fam'd father's hand,
Great Cibber's brazen, brainless brothers stand."

Cibber was, like Pierce, an assistant of Wren, working for him on the Monument, on which he executed the great bas-relief representing the restoration of London, at Hampton Court, Trinity College, Cambridge, and St. Paul's. He did most of the statues for the Royal Exchange, and was the architect of the old Danish Church in Wellclose Square, besides executing much decorative work at Chatsworth, both indoors and out. He produced an admirable *genre* statue of the Blind Piper, and the statue of William of Wykeham at Winchester, the latter a species of bribe addressed to the authorities to procure the election of his son Lewis to the foundation as Founder's Kin. A portrait or two, some wooden statues of Saints, a Berninesque fountain in Soho Square, with statues of Charles II. and four river-gods, fairly represent his output, though his best work is to be seen in two monuments which rank among the noblest of their day. These are the glorious Sackville tomb at Withyham, Sussex, showing the parents of Lord Richard Sackville kneeling on either side of the recumbent figure of their son, and the stately monument of Heneage Finch, Earl of Nottingham, at Ravenstone, Bucks, this last not hitherto included among his works, though Finch tradition, confirmed by the style, declares it to be his. The same tradition states that the sculptor was so distressed by the squint he had given to the figure that he committed suicide, but the legend, as in the case of another monument in Winchester Cathedral, is clearly a case of *post hoc, propter hoc,* since Vertue, who knew much of him, never heard of it. "He was a gentleman-like man and a man of good sense, but died poor, left a son a player," is the antiquary's brief epitaph on a sculptor who imitated Bernini in his fountains, worked with and for Wren and Bird, and impressed generation after generation with his following of Michael Angelo in his *Raving and Melancholy Madness* which may without exaggeration be termed the strongest imaginative work executed in England between the Restoration and the rise of Roubiliac.

The romantic story of John Bushnell (d. 1701), most inadequately told by Walpole, deserves to be more widely known. He left his master, Thomas Burman, one of the last of the school of English alabaster sculptors, for foreign travel, spent two years in France and visited Italy, not Rome only, but Venice. "He took pleasure," as Hogarth's father-in-law, Sir James Thornhill, told Vertue, "to travel as a poor fellow and workt in several towns. At first, with Masters, he would enter himself as a labourer or poor fellow, and after some time, surprise them by doing better and better." His unidentified monument at Venice, like his work at Hamburg, which he visited on the way home; his disappointment over the Royal Statues on the Exchange, of which he did only two instead of all; his figures on Temple Bar; his glorious Mordaunt monument at Fulham, so long unjustly attributed to Bird—for these things the reader must be referred to *The Architect* (October 7th, 1921). His life was a failure. Contemporaries laughed at his figures, "great and spirituous" as

of Winckelmann, the pioneer of the modern study of Greek art, and the Neo-classic school of sculptors who broke with the existing traditions and deliberately based their work on Greek or rather Græco-Roman art. What this meant may be seen by contrasting the work of Flaxman and Canova with that of Bernini, the recent acquisition of whose bust of "Mr. Baker" by the Victoria and Albert Museum is an event of national importance. A comparison of this work with Pierce's bust of Wren here illustrated will show the source of the younger sculptor's inspiration.

Vertue justly found them. His projects miscarried; his one colossal oil painting "of a Triumph," found no purchaser; his very house in Park Lane, "the lane from Piccadilly to Tyburn," remained unfinished. He lost his money in a scheme for bringing coals to London by sea; he lost his estate in Kent by a lawsuit; he lost his reason; his model of the Trojan Horse, a sort of glorified drinking booth, in whose head twelve men could sit, was wrecked by a gale; and his only consolation was the devotion of his family, two sons and a daughter, who lived on in the desolate half-finished house and told Vertue, who had a long interview with them in 1725, and saw with pity the ruined relics of poor Bushnell's ambitions, that the world was not worthy of their father.

Some idea of the peculiarities of Bushnell's style may be gathered from the Charles I. and II. which the writer identified last year in niches on the first landing of the Old Bailey, which, with Gibbons' Charles II. in the Royal Exchange, are now the sole survivors of that lost Pantheon of the English Kings, the Royal Exchange of 1667. The Berninesque draperies, the intense unresting vigour of the lines, make them unique among English sculpture, though, like the statues on Temple Bar, they are marred by a certain amateurishness which is even more conspicuous in other works, and is wholly lacking only in the splendid figure of Viscount Mordaunt at All Saints', Fulham, his undoubted masterpiece.

If Pierce, on the strength of his portrait busts, may be called the English Bernini, Bushnell is no less unquestionably the most Berninesque of our decorative artists. The proud swell and volume of his draperies, the vitality and poise of his figures, are unique in English statues; the Charles I. would not be out of place on the Bridge of St. Angelo, nor the Mordaunt, a work finer because intended to be seen at closer quarters, in St. Peter's.

Grinling Gibbons (1648-1721), best known as a woodcarver, is also a considerable sculptor whose two statues of Charles II. at the Royal Exchange and Chelsea Hospital, and the far finer James II. at Whitehall, should endear him to all Londoners. He also executed tombs of varying sizes, from the colossal Campden monument at Exton, Rutland, to the miserably defaced slab to William Courten in St. Mary Abbot's, Kensington; two excellent fonts, those at St. James's, Piccadilly, and St. Margaret Lothbury; and much of the stone work at Hampton Court, as well as various portraits of which the most accessible is the charming medallion of Wren at the R.I.B.A. To enumerate his masterpieces in wood is quite impossible. From St. Paul's to Canterbury, from Petworth to Cambridge, England is full of them, and Walpole's verdict that he "gave to wood the loose and airy lightness of flowers" remains unassailable. Working in bronze, marble, stone, wood, and ivory, raising himself from the humble youth who, as Stone's nephew told Vertue, "had a shop at Deptford" and was there discovered by Evelyn at work upon "that large cartoon of Tintoret," which Evelyn found it hard to forgive the Court for ignoring, he subsequently became Master Carver to every English sovereign from Charles II. to George I. But his head was never turned; he inspired his assistants with his own enthusiasm—one of them lost his life in a successful attempt at saving

FIG. 3.—FONT IN ST. JAMES'S, PICCADILLY. By GRINLING GIBBONS.

the carved room at Petworth—and remained always what Evelyn had found him as a youth, "very civil, sober, and discreet." He died at a good old age in 1721, and was buried near his last bust of Sir Peter Lely in St. Paul's, Covent Garden.

The great artists of the reign of George II., Scheemaker, Rysbrack, and Roubiliac, are men of different calibre. All came to England when very young, and all lived and worked in their adopted country. Peter Scheemaker (1690-1771?), a Fleming of great natural gifts, improved his art by sheer hard work in Italy, and was the first of our sculptors to have an historical conscience. He studied his Edward

VI. at St. Thomas's Hospital from Holbein's picture, his Shakespeare in Westminster Abbey from the Chandos portrait; modelled his Ancient Worthies at Stowe on the Antique; copied Michael Angelo, Bernini, and Fiammingo for practice; and erected countless monuments varying in scale from the small to the colossal, but never careless or negligible.

John Michael Rysbrack (1693-1770), the greatest historical sculptor whom England has seen, has a finer sense of design and is a far finer craftsman. His terra-cotta models in the Soane Museum are works of art, and he succeeds in more fields than any other English sculptor. Whether his subject is an equestrian statue, an historical scene, an allegorical bas-relief, a living man or a dead hero, he treats it with originality, power, and that sense of style without which art cannot exist.

But if Scheemaker and Rysbrack were excellent artists, Louis François Roubiliac (1695-1762) was, in Allan Cunningham's words, "a genius and a gentleman." As I have elsewhere shown, he came to England far earlier than is commonly supposed, and never left it save for a brief visit to Italy. He executed the best portraits of the greatest men of his day, Swift, Pope, Handel, Hogarth, Garrick, Bolingbroke, and knew most of his sitters intimately besides; his monuments are masterly; his statues, of which the Newton at Trinity is only the most famous, noble works of art. "Ruby," as Fielding affectionately called him, was loved by all who knew him, and met his death through devotion to his art. Adequately to deal with his work would need a volume; but no account of English sculpture during the century from the Restoration to the death of George II. can omit a tribute, however brief, to its last and greatest artist.

BIBLIOGRAPHY.

The Vertue MSS. apart, the principal sources of information are very few, and many of the dates and particulars here given will be found to contradict those usually printed. The authority of the MSS., however, is overwhelming, since Vertue wrote from personal knowledge of all the sculptors here mentioned, Pierce excepted. The relevant passages have been printed in full by the writer in *The Architect*, 1921-2, and must be accepted in place of the inaccurate and second-hand statements found elsewhere.

Architect, The. Studies of the English Sculptors from Pierce to Chantrey [by Katharine A. Esdaile]: July 1, July 8, September 2, September 16, September 30, October 7, October 21, December 9, 1921. February 10, March 3, April 7, April 21, June 16, June 23, 1922; in progress.

Chancellor, E. Beresford: *Lives of the British Sculptors*, 1911.

Cunningham, Allan: *Lives of the English Sculptors*, 1831.

Dallaway: *Anecdotes of the Arts in England*, 1800. Inaccurate and scrappy.

Dictionary of National Biography, s.v. Pierce, Cibber, Gibbons, Bushnell, Scheemaker, Rysbrack, Roubiliac.

Esdaile, Katharine A.: See *The Architect*.

Faber, Harold: *Danske og Norske in England*. Copenhagen, 1915. By far the best account of Cibber, though omitting one or two important works.

Sainte Croix, Le Roy de: *Vie et Œuvres de L. F. Roubiliac*. Lyons, 1882. An enthusiastic appreciation, whose value is lessened by the author's ignorance of English and by his constant inaccuracies.

Smith, J. T.: *Nollekens and his Times*. Ed. Wilfrid Whitten, 1920. (John Lane, £1 11s. 0d.) Indispensable

Walpole, Horace: *Anecdotes of Painting in England*. Ed. Wornum. (Out of print.)

Most indispensable of all is the study of the monuments themselves; provisional lists of works by the various sculptors will be found in *The Architect*.

Notes and News of the Month

ARTIFICIAL DISINTEGRATION OF THE ATOM.

THE attention of the public has been recently called by a section of the Press to the unpleasant eventualities which recent work on the artificial disintegration of the atom has made possible. Reports, of course, have been greatly exaggerated, but many would like to know whether or not any truth whatever lies at their base. We have been told that "an atom may blow up the Earth," that "the world is on the verge of the greatest scientific triumph of the ages," that hot stars may have evolved from cold earths like ours because beings living on them "have been monkeying with their atoms," and so on. It is a pity that newspapers make stories out of a little of the latest science, a few interviews with scientific men suitably embellished, a vivid imagination and a breezy or a forced breezy style. It is a pity, too, that there should be such a great gulf fixed between the science of anticipation—that glorious, exciting, gripping, and romantic thing which really interests us all—and the science of real things discovered in laboratories by patient men, who fortunately escape being interviewed, which by comparison is almost a thing of naught.

It is well known that artificial disintegration has been effected in the laboratory—a great and very important advance in science. But the study of the phenomena involved has taught how extremely difficult a process it is, and on what an excessively minute scale it has yet been effected. Special materials are required which are extremely rare in nature, and which, apparently, cannot be manufactured. The conclusion from these experiments is that there is little or no hope either of the process of artificial disintegration being rendered possible on what is called a commercial scale, or (what is nearly the same thing) that boundless quantities of energy can somehow be generated by the process by which so far a little has been tapped. And these are the only experiments which

have led to positive results. There are other experiments, however, on which speculation sets great hopes, which consist in outline (as one newspaper put it) in giving "the solar plexus of an atom a two million volts punch." But so far such punches have done nothing. Perhaps some day they will, but that is another story. Advances in science to-day as in the past are real enough but gradual—very gradual. It is best to wait and see; and, to see the advance in realities, a fairly large-scale map is necessary.

A. S. R.

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PROGRESS OF CIVIL AVIATION.

The latest Half-Yearly Report on this subject published by the Air Ministry contains facts and figures worthy of attention. It covers the period October, 1921—March, 1922. The period shows an increase in British carried passenger traffic with the Continent over that of the same period in 1920-1921, the total number of passengers carried on British machines being 1,686, as compared with the previous 1,418. This period has established a safety record, for there was not a single fatal accident to any machine of any nationality.

Arrangements are being made for opening the English section of the London-Paris route for night flying. Aerial route lights are being set up at Tatsfield Hill and Cranbrook, and an automatic illuminated ground sign, which will be situated at Penshurst emergency landing ground. These various lights will operate for a year without attention. In addition, an automatic wind indicator for night flying has been completed at Croydon, while the progress made with searchlights and other apparatus designed to simplify night landing has placed the Croydon and Lympne aerodromes in a position to cope with night services at short notice.

Some interesting details are given of projects and undertakings in other countries. In Australia, for instance, tenders have been received from various firms and accepted by the Government, not only for the Geraldton-Derby air service, but for working lines between Sydney and Adelaide, Sydney and Brisbane, and Charlieville and Cloncurry (Central Queensland). When these plans are put into effect, direct overland communication will exist between the north and south regions of Western Australia, Geraldton being connected by rail with Perth, while South Australia, New South Wales, and Queensland will be placed in quick touch with one another. It is to be expected that Germany will now forge ahead with air schemes, for last February the Conference of Ambassadors fixed May 5th as the date on which the Republic might resume the manufacture of civil aircraft. At present there are in Germany five important air transport companies, and twelve air routes have been approved for regular operation by the Ministry of Transport. We may also see Sweden playing an important part in Continental air travel before long, for the Swedish Aeronautical Commission's report on civil aviation recommends the establishment of three air lines—Stockholm-Goteborg, with connections to Petrograd and London, to be operated by airships; Stockholm-Malmo, with connection southward to the Continent; Malmo-Goteborg, with a connection to Christiania. Suggestions are also put forward for a direct airship service between Stockholm, Berlin and Southern Europe. In the United States the chief use of air flight has been made by the Post Office, 25,496,560 letters having been thus carried during the period July 1st, 1921, to June 30th of this year.

Another announcement from the Air Ministry informs us that a new company, probably with the title of the British Marine Air Navigation Company, Ltd., is being formed to operate services between Southampton and the French ports of Cherbourg and Le Havre, and possibly later a Channel Islands service. The existing British services use land types of aircraft only, but the new company intends employing special marine aircraft.

E. L.

* * * * *

SPINOZA.

Those of our readers who have investigated, slightly or deeply, the doctrines of pantheism will be interested to hear that an international society (*Societas Spinozana*) has been lately formed for the study of the philosophy of Spinoza. This most famous of all modern advocates of pantheism was born at Amsterdam in 1632, and died at the Hague in 1677. His system of philosophy considered God as both the cause and substance of the universe, advocated the necessity of the Divine nature, and abolished the idea of free-will.

The new society proposes to hold conferences at fixed intervals, to reissue rare books and documents relating to Spinoza, and to publish an annual volume of original studies. The first volume of these studies has already been published, and includes contributions from Dr. Harold Höffding, Sir Frederick Pollock (who is English representative on the Society), and Professor Léon Brunschvicg. It is printed with type specially cast in imitation of the fount used in the original edition of the *Ethics*, Spinoza's most important work, which was not published till after his death.

The headquarters of the society are at the Hague, but British persons interested in its work are invited to communicate with Mr. L. Roth, Exeter College, Oxford.

E. L.

Reviews of Books

THE POPULATION PROBLEM.

The Population Problem: A Study in Human Evolution. By A. M. CARR-SAUNDERS. (The Clarendon Press, Oxford, 21s.).

Mr. Carr-Saunders' study of the population problem is planned on comprehensive lines. As his sub-title indicates, it is not a contribution to the discussion of any one aspect of the problem; it deals with the whole, or, at any rate, with the main features, from an historical and evolutionary point of view. The chief elements in the problem are traced back to their origin in the biological, anthropological and economic factors which determine the way in which any collection of individuals is organised as a human society. In so far as it does this, it advances discussion by a clear-cut statement of the essential elements of the problem; but its appeal is directed not so much to the specialist as to those who have a general interest in the question. For such readers Mr. Carr-Saunders' careful and lucid summary of the evidence afforded by the latest researches in connection with reproduction, heredity and variation, and their bearing upon the question of the numbers and the character, both physical and mental, of any given population will be of great value. He is to be congratulated upon the ability with which he has so handled his material—material, be it said, of a highly technical character—as to render it intelligible to those who have no intimate acquaintance with the data of the sciences from which he has drawn his arguments. It must be accounted as a merit that the book is written throughout with regard to the anthropological point of view. It must also be admitted, however, that the author's style does not make for easy reading, and is even at times a little irritating.

The discussion of the population problem may be said to begin with the publication by Malthus in 1798 of his *Essay on Population.* His views had to some extent been anticipated; but the subject had received little more than superficial or partial treatment by classical, mediæval and earlier modern writers. In the main, interest had been directed to the question of numbers. The desire for national aggrandisement had focused attention on the desirability of a large population. Malthus expounded the relation of population and food supply. He maintained that, while population increased in geometric ratio, the food supply increased in arithmetical ratio only; but that undue increase of population was checked by vice, disease and misery. Although the accuracy of his data was impugned, his views had a profound effect on the thought of the nineteenth century, notably in their influence on Darwin and Wallace.

Mr. Carr-Saunders bases his examination of the problem on the relation of fecundity (potential production of offspring) and fertility (rearing of offspring). In Nature, he points out there tends to be a more or less constant balance. Notwithstanding the large number of offspring which may be produced, especially among the lower organisms, a variety of checks operates to secure that the number of adults remains fairly constant. These conditions once applied equally to the ancestors of man. Owing, however, to the evolution of reason, the problem now assumes an entirely different form. There appears in the case of man to have been an increase of both fecundity and fertility. The author is of the opinion that human fecundity is usually underrated, and in this connection it is of interest to cite some of his figures. A population of a million, half males and half females, each couple producing two children before the age of twenty, and themselves then dying, would, he estimates, produce a constant population of one million; but with an average of two-and-a-half children the population would increase to 3,050,000 in one hundred years, while an average of five children would produce 97,650,000 in the same period.

As it is obvious that the human race has not increased and does not increase at anything like this rate, Mr. Carr-Saunders' aim has been to show what are the causes at work to keep this rate of increase in check. He finds that there appears to be an optimum[1] number in any given society to which population tends to approximate. The checks operative among species in a state of nature, that is the dangers to which offspring are exposed, decrease, but their place is taken by others. Numbers may be kept down by natural selection, but there tends to be some partly conscious adjustment on the part of individuals. In a very able review of the anthropological evidence afforded by primitive peoples, he shows that a variety of factors tend to keep the population somewhere near the optimum level. Among these are intercourse before puberty, contraceptive methods, abortion, infanticide and analogous practices, as well as prolonged lactation, lack of care of children, war, disease and migration. No one of these appears to be peculiar to any one grade of culture; they appear whether the community be engaged in hunting and fishing, pastoral pursuits, or in agriculture. The explanation of this fact probably is that communities confining themselves exclusively to one mode of existence are the exception, whereas in the evidence adduced by the author, the main occupation is made the basis of classification and treated as if it were the sole occupation. Indeed, he himself points out how the prevalence of the different varieties of checks varies according to conditions. Among a nomadic people, for instance, one of the factors in determining the number of a young family will be availability of means of transport for children. This would probably operate in the direction of one set of checks, while a mode of existence, partially nomadic, partially agricultural, such as is found

[1] Optimum number in this connexion means that number at which in any given society there is such a balance between population and means of subsistence as will secure the most favourable conditions for the individual and the community as a whole, having due regard to the stage of development in civilisation of that society.

among tribes of nearer Asia, would operate in the direction of another set. From the nature of the case, however, evidence is partial and scanty. Not only do the checks on population vary, but the optimum number also is not constant, and varies in like manner with the conditions. Mr. Carr-Saunders' analysis of conditions in the Middle Ages and their effect on population, which bears out these points well, is extremely interesting and worthy of close attention.

The problem which Malthus stated as one of food supply is now seen to depend rather upon the relation between density of population on the one hand, and the maximum return of industry on the other. So long as skill increases, so long will it continue to be desirable for the population to grow larger. A population which is either too large or too small will fail to attain the maximum return of industry. Mr. Carr-Saunders is of the opinion that in India, Egypt and China we have cases in which the checks operating on increase of population are not adequate, and over-population probably occurs. He shows further that in a primitive society the balance between density of population and the maximum return of industry is dependent upon two factors. The first of these is that in a primitive community, whether sedentary or nomadic, the tribal boundaries are strictly defined—a fact which is often overlooked by writers on primitive society—and the means of subsistence are consequently subject to definite limitation. The second is that there is among primitive peoples complete social co-operation in providing the necessities of life. It is clear that, in so far as any society fails to secure complete co-operation among its members, we cannot say that there is any fixed number of population which would be the best in the interest of the whole community. It is, however, doubtful how far the complete social co-operation which the author postulates in theory would be found, even among primitive races, in practice.

In order to survey the specifically human aspects of the biological problem, Mr. Carr-Saunders places before his readers a lucid summary of the geological, palæontological and anthropological evidence relating to the antiquity and descent of man. It would perhaps have been an advantage had this evidence been a little more fully discussed, especially in regard to the relative merits of the various time measurements put forward for the different geological epochs upon which the evidence for the antiquity of man depends. Presumably he does not consider that this evidence (nor even some recent discoveries and investigations, notably that of the Rhodesian skull, unless indeed this was made too recently for consideration) materially affects his argument. He holds that by late Palæolithic times man's evolution, both physically and mentally, was to all intents complete; and he concludes that we may assume that the checks operative among primitive peoples were also operative among prehistoric races. This conclusion, however, is subject to a reservation. He holds that it must not be too readily assumed that conclusions based upon the practices of primitive people are completely applicable to prehistoric times. This is a perfectly sound measure of precaution, frequently overlooked by too eager students of the mentality of prehistoric man.

Mr. Carr-Saunders' analysis of the qualitative aspect of the problem, *i.e.*, changes of type of population, an aspect which he regards as indissolubly linked with the quantitative, is of extreme interest, but unfortunately lack of space precludes its adequate discussion. His treatment of it is hardly as successful as his handling of the quantitative aspect, *i.e.*, of increase and decrease of population, and it is impossible to avoid the conclusion that he has not always thought out his argument clearly. He holds that three factors, germinal constitution, environment and tradition, enter into the problem. The distinction drawn between environment and tradition is little more than formal, and it would be difficult as a practical matter to separate the two. While recognising the existence of mental differences arising out of differences of race, in Europe, for instance, he does not appear to have considered the bearing of differences of race upon the character of the population within a social organism such as that of this country, where further investigation may, and probably will, show that such differences are of more than academic interest, and have no inconsiderable importance in relation to a number of social problems. Mr. Carr-Saunders' final conclusion is, however, that "The course of history is in the main dependent upon changes in tradition. . . . . As far as tradition is equalised . . . to that degree is mental endowment of pre-eminent importance to the individual." With that message of hope to the reformer and the eugenist this notice may fittingly end.

E. N. Fallaize.

AN ENTHUSIASTIC MOUNTAINEER IN NEW ZEALAND.

The Conquest of the New Zealand Alps. By Samuel Turner, F.R.G.S. (T. Fisher-Unwin. 21s.).

Few climbers have had a wider experience of the summits of the world than Mr. Turner. Twenty-four years ago he began his climbing in the Swiss Alps. Since then he has never tired of the pastime, and has pursued it in the Alps, the Albai Mountains of Siberia, and New Zealand, with a tentative venture in South America on the slopes of Aconcagua. In the intervals of more serious work, Mr. Turner kept himself in practice by winter rock climbing in England and Wales, or by what seems to be the extraordinarily dreary exercise of skipping. We gather that he prides himself on holding the record for one hour's non-stop skipping, which entailed over 10,000 skips. Climbing has always been Mr. Turner's pastime, to which he has devoted himself in intervals between his business affairs, but it was only when he settled in New Zealand in 1911 that he could satisfy a longing to tackle the little known New Zealand Alps. The book records seven years' climbing, from 1912 to 1921. In each year the climbing season was fully occupied, and many victories were gained.

The summit of the New Zealand Alps is Mount Cook.

which has an altitude of 12,349 feet. There appear to be several routes to the summit, and the mountain was first climbed in 1894. Since then it has been ascended over twenty times. In recent years scarcely a season has been missed. But Mr. Turner was ambitious to achieve a single-handed ascent. Such a feat entailed some risk, but to Mr. Turner it promised a unique pleasure. "Twenty-four years' mountain exploration and climbing have made me exhaust nearly all the pleasures of the climbing craft, except solitary climbing. The virgin peaks climbed by me alone. . . . . are the outstanding features of all kinds of ascents of various degrees of difficulty on this globe during my climbing career." Six attempts in various years failed owing to unsuitable weather, but eventually Mr. Turner satisfied his ambition, and was so proud of his achievement that he not merely employed witnesses at a lower altitude to see him on the summit, but prints their certificate. Why trouble to prove what no one wishes to doubt, especially when the climb, according to Mr. Turner's own admission, was made to satisfy himself alone? As he says: "The real climber will climb even if there be only the mountain to witness the feat." Another good climb was that of Mount Tasman, the second greatest altitude in New Zealand, and only 874 feet lower than Mount Cook. It was, however, in his Mount Tutoko expedition in 1919 and 1920 that Mr. Turner broke the most interesting ground. There he was in a little known and imperfectly surveyed region, and succeeded in discovering a new lake as well as clearing up some doubtful details of the topography. He climbed to within a few hundred feet of the top of Mount Tutoko, and showed that this name which belongs to the highest peak in the district has not infrequently been wrongly attached to the somewhat lower Mount Madelaine.

The whole book will be of great interest to climbers from the detail the author gives to describing various difficult problems he encountered. A happier literary style would endow many of the situations with a thrill which they miss in the telling. The author's sentences are frequently awkward, and his style is apt to offend the reader. A careful revision would not have been amiss.

Mr. Turner rightly believes that New Zealand offers a fine field for the enthusiastic mountaineer, but weather conditions around the highest peaks are very uncertain. Snowfall, even at midsummer, is often heavy, and lies at about 2,000 feet. The peaks rise from relatively low levels, which necessitates quick travelling in order to take advantage of fine weather. December to February, and in some respects March, appear to be the best months for climbing. Some notes on the author's methods of training for his mountaineering are of interest. Mr. Turner, we gather, climbs for recreation, believing in a strenuous holiday in order to fit himself for business. He finds climbing keeps him young and fit, and we can well believe it when we read of some of the feats in which he rejoices. We have already noted the use of the skipping rope. A thousand skips in five minutes as a daily exercise, playing tennis in mountain boots (he says nothing of the court), Swedish exercise, wood-chopping, and the yearly ascent of certain peaks at a fixed speed, are all devices used by Mr. Turner. And to test his nerve, which seems never to fail him, he indulges in feats of balancing on lofty ridges and high summits, where the average man would feel well satisfied if he could merely stand upright. To a man so devoid of giddiness, mountaineering must indeed be a joy. Those who share this quality will find pleasure in the book. The illustrations are good.

R. N. Rudmose Brown.

Books Received

(Mention in this column does not necessarily preclude a review.)

MISCELLANEOUS SUBJECTS.

The Home of the Indo-Europeans. By Prof. H. H. Bender. (Princeton University Press, and Humphrey Milford, Oxford University Press, 4s. 6d.)

Greek Biology and Greek Medicine. By Charles Singer. (Oxford: At the Clarendon Press, 2s. 6d.)

The Book of Genesis. Translated into Colloquial English by Prof. T. H. Robinson, M.A., D.D. (National Adult School Union, 1s.)

Essays on the Depopulation of Melanesia. Edited by W. H. R. Rivers, M.D., F.R.S. (Cambridge University Press, 6s.)

The New Decameron. The Third Volume, containing stories by Compton Mackenzie, J. D. Beresford, D. H. Lawrence, etc. (Basil Blackwell, 7s. 6d.)

The Peoples of Europe. By Herbert John Fleure, D.Sc. (Oxford University Press, 2s. 6d.)

The World About Us. A study in Geographical Environment. By O. J. R. Howarth. (Oxford University Press, 2s. 6d.)

Short, carefully written, accurate, and up-to-date descriptions of these subjects, written by specialists for the non-specialist but serious student. Few books are so fresh and stimulating, as well as informing, and for the price, so well printed, as these. The inclusion of both a bibliography and an index would be a boon to readers. Prof. Fleure's book contains the former, and Mr. Howarth's the latter only.

SCIENCE.

The Discovery of the Circulation of the Blood. By Charles Singer, M.D., Litt.D., F.R.C.P. (Geo. Bell & Sons, 1s. 6d.)

This book is nicely printed and suitably illustrated, and has eighty pages in a stiff paper cover. It is the first of a new series entitled "Classics of Scientific Method," which promises to be a good one. The aim of the series

is to provide reproductions of the great masterpieces of science in a convenient form, together with a fairly complete account of the action and reaction of ideas which, through the process of time, led up to the crucial experiments carried out and described by some great master. This account by Dr. Charles Singer of Harvey's discovery of the circulation of the blood could hardly be bettered. His first chapter tells what the circulation of the blood is in the plain language of to-day; the second and later ones describe the knowledge of the vascular system in antiquity, and how the revival of learning and the early work of such men as Vesalius and Servetus led to Harvey's brilliant work early in the seventeenth century. The book is astonishingly interesting, partly, no doubt, because of its subject-matter, but partly also because it is written by an authority who knows and loves the subject he is describing. It is recommended whole-heartedly to our readers.

The Language of Anatomy. Tract No. IX. of the Society for Pure English. By WM. CUTHBERT MORTON, C.B.E., M.A., M.D., and ROBERT BRIDGES, M.B., F.R.C.P. (Oxford: Clarendon Press, 2s. 6d.)

The gist of this paper by Dr. Morton and the Poet Laureate is to offer practical suggestions for the Englishing of the terminology of anatomical science. Its import is to condemn the action of those who are moving to introduce a formal Latin international terminology into the British Schools of Anatomy; it is argued that such action is wrong in principle and harmful in practice. The authors contend that all scientific nomenclature must have its basis in every national language, and that whatever classical or foreign terms are introduced should be as far as possible adapted to the national speech.

The Green Ray. By PROF. M. E. MULDER. (T. Fisher-Unwin, 6s.)

A monograph on the green ray or green flash seen, or, according to some, alleged to be seen, at the rising and the setting of the sun. Previous descriptions of this ray and opinions about it are discussed. The author is not dead sure of himself, but he favours the "dispersion" theory of its existence, and is against believing it to be an "after-image" phenomenon.

Chemistry for Beginners and Schools. By C. T. KINGZETT, F.I.C., F.C.S. Fourth Edition. (Baillière, TINDALL & COX, 5s.)

La Notion d'Espace. By D. NYS, Professor in the University of Louvain. (Brussels: Les Editions Robert Sant; London: Humphrey Milford, 15s.)

Mechanics. Part I. By GEORGE THOMPSON and GEORGE H. LESLIE, B.Sc. (Cassel & Co., Ltd., 2s.)

A new volume in a series which has been previously noticed.

The Report of the National Physical Laboratory for the Year 1921. (Sold by H.M. Stationery Office, 6s. 6d.)

THE WORLD'S LARGEST TELESCOPE AND ITS REVELATIONS.

The New Heavens. By GEORGE ELLERY HALE. (Charles Scribner's Sons, 7s. 6d.)

The general reader, that indefatigable person for whom authors strive to write books and reviewers agonise to explain what they are about, will find Dr. Hale's book a revelation and a delight. It is a short book of eighty-eight pages containing in them no less than forty illustrations, most of them photographs of distinction, but every page is good. The author has a first-hand knowledge of his subject, for he is the director of the Mount Wilson Observatory (California) of the Carnegie Institution of Washington. And his method of treatment and style are excellent and well suited to the general reader; indeed, part of the book has already appeared in *Scribner's Magazine.*

The book has three chapters. The first contains a description of the 100-inch Hooker telescope—the largest telescope in the world—what it is, and what can be done with it; the second describes giant stars, and gives an account of the determination of the angular diameter of Betelgeuse by the interferometer method; the third is entitled Cosmic Crucibles, and deals with the enormous pressures and temperatures of certain stars and the relation of these to the building up of the heavier elements from lighter ones.

The photographs reproduced are excellent and instructive.

A. S. R.

Correspondence

RADIATIONS FROM SLOW RADIUM AND THEIR THERAPEUTIC VALUE.

To the Editor of DISCOVERY.

SIR,

YOUR REVIEW.

The short notice which appeared in your Journal of May, 1922, page 139, has just been brought to my notice.

It deals with an unfair and incorrect review of my book entitled:—

"Radiations from Slow Radium; by John B. Kramer;
And their therapeutic value; by Major John F. Hall-Edwards, L.R.C.P. (Edin.), D.M.R.&E. (Cantab.), F.R.S. (Edin.), Hon. F.R.P.S., late R.A.M.C."

Your critic, when reviewing a book, might at least be accurate before he accuses anyone else of "inaccuracy." He quotes the title of my book—I should say, disingenuously—wrongly. Will you please correct this in your next issue?

Then he "throws mud"—without qualification: and "runs away"—anonymously.

His criticism is priceless, and his argument, that "Radium is Radium," exposes his logic. (I presume he means it does not matter how it is applied—strong or weak—quick or slow—as long as "Radium is Radium.")

As to his accusation that my book, "containing several very inaccurate descriptions of simple scientific facts"—I must at once say that he cannot prove one single statement in my book as being inaccurate.

I can only conclude that your critic does not understand the book, its purposes, and its value. He is of the opinion therefore that it should never have been written. (*Sic.*)

Will you permit me to inform him that among the numerous letters of satisfaction and congratulation I have received are many from eminent medical and scientific men, also that the theory I advocated has since been put to severe tests by medical men, who are pleased with the good results obtained. Reports will appear in due course in the Medical Press.

If, therefore, my suggested Treatment is right and apparent, men of your critic's calibre must evidently only possess a smattering knowledge of Radio-activity for Therapeutic purposes, and are, therefore, afraid to give their reasons for their "mud throwing."

A copy of this letter, together with a copy of the criticism in your May number (in case this letter is refused the hospitality of your Journal) will be sent by me to all those who have expressed themselves as pleased with my book, and also to all future readers.

I think it is time that such unscrupulous and incompetent criticism should be stopped or exposed.

Yours, etc.,

J. B. Kramer.

Wheatsheaf House,
Wheatsheaf Road,
Edgbaston.
5th July, 1922.

REPLY BY OUR REVIEWER.

Sir,

Let me take Mr. Kramer's points in turn.

(1.) The complaint about the title is neither justified nor important. There are three variants of it, one on the cover, which is the one I took and reproduced accurately, a second on the back of the book, a third on the title page. The one given in Mr. Kramer's letter above makes a fourth. It is a mis-quotation of that on the title page, which was not used, as it was too long.

(2.) I do not "throw mud without qualification." Part of my review was praise, part criticism. In some ways I thought the book a bad one and said so. The criticism was honest. I have a large experience in reading scientific books, and I may claim in all modesty that I know as much about Mr. Kramer's subject as he does.

(3.) Anonymity is not a crime. Short reviews in *Discovery* and many elsewhere are anonymous. To describe a custom as cowardice is absurd.

(4.) Mr. Kramer asks me to prove a single statement in his book as inaccurate. Easily done. On page 6 there are ten sentences, seven of which contain misstatements. He says there, for instance, that zirconium is a radio-element. Untrue. He says that the process of disintegration of the thorium atom lasts 6,000 years. Actually, the period of average life of thorium atoms is about 18,000,000,000 years! And so on. On page 5 he says: "If one could add or subtract a certain number of millions of electrons per atom, one element would be converted into another without more ado." No one who understands the subject talks about electrons in millions. From one to approximately a hundred is roughly the number. And the statement itself is not true. The chief point about converting one element into another is that the nucleus and not the attendant electrons must be altered. Again, although he describes it correctly elsewhere in the book, he says of radio-activity on page 5: "It means nothing else than the issue of the electrons from the womb of the atom." But it does. The most characteristic radiation from a radio-element is a particle which is not an electron, but a helium atom minus its electrons. In different parts of the book there are errors not trivial and excusable, but such that they reveal the author's ignorance of the subject he professes to write a book about.

(5.) I am not concerned with the complimentary reviews and letters Mr. Kramer has received. I should indeed be surprised if journals like *Nature* or *Science Progress* praise the book, but obviously a reviewer's job is to give his own opinion and not those of other people. The book appeared to me to be badly written and inaccurate from the scientific point of view, a rather weak and erroneous account of well-known facts. And I thought so, and still so think.

Yours, etc.,

A. S. Russell.

THE PACIFIC BASIN AND AMERICAN CONTINENT.

To the Editor of Discovery.

Sir,

With reference to the article by Prof. Wegener in the May number of *Discovery*, there is no mention of the theory of the breaking off of the Moon from what is now the Pacific Basin. This, if proved, would explain why there should be so little (comparatively) of the earth's outermost skin; and also the quicker movement of the Americas as compared to the rest, since, being nearest in the line of motion to the vacant space, the westernmost part of the continental mass would be most strongly attracted to fill it.

Yours, etc.,

P. T. English.

Montserrat,
B.W.I.
24th June, 1922.

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Editorial Notes

We have long passed those days when a famous missionary wrote the lines:

> "Though every prospect pleases
> And only man is vile."

True, one meets people from time to time who call all races, whose skin pigmentation is darker than that of the European, by the name of "niggers," and who cannot understand any point of view concerning them except that of regarding them as so much potential labour to benefit the white man. But such persons are fading away into a minority, and white civilisation as a whole has for a long period endeavoured to apply to the particular subject races under its control an attitude not merely of tolerance, but of understanding and sympathy both in thought and action.

In two notable instances, indeed, within the British Empire, special attempts have been made to preserve the original native races. A careful segregation of the Red Indians has been adopted in Canada, while in Australia the aborigine has been allotted a sanctuary consisting of 65,700 square miles on the borders of South Australia, Western Australia, and the Northern Territory.

* * * * *

We have, however, to face a most unpleasant fact, and that is the decadence which sets in amongst the majority of primitive or semi-primitive races after the white man has come into their midst. Moreover, amongst tropical peoples the arrival of white civilisation results not only in moral and physical decadence, but in depopulation on an extensive scale. Recently two important books have appeared on this subject, and we feel that it will not be out of place here to summarise the information and conclusions which they offer. The first book is a collection of papers by doctors, missionaries, and Government officials on depopulation amongst the Melanesian inhabitants of the Western Pacific archipelagoes, edited by a famous Cambridge psychologist, who made personal investigations on the spot.[1] The second is the account, by a well-known Alsatian theologian and doctor, of his four and a half years' experiences as a medical missionary amongst the natives of the Ogowe district, which lies between the mountains of Central Africa and the Gulf of Guinea.[2]

* * * * *

It must be admitted that the evidence in the first book is rather conflicting, though the evils which European contact with the natives of Melanesia has produced are undeniable and may be roughly summarised as follows: depopulation and physical decadence have chiefly resulted from (*a*) the introduction of Western diseases, particularly of venereal diseases; (*b*) the sale of alcohol and opium; (*c*) the wearing of clothes; (*d*) the recruiting of labour which takes men and women away from their islands to other islands. With regard to the last two causes. In many islands, before the arrival of the white man, no clothes at all were worn; in others, the men wore loin-cloths and the women small skirts. Such clothing was amply sufficient, and it is amply sufficient now. Both traders and missionaries have been responsible for the introduction and encouragement of clothes, though too much blame has, perhaps, been attached to the

[1] *Essays on the Depopulation of Melanesia.* Edited by W. H. R. Rivers, M.D., F.R.S. (Cambridge University Press, 6*s.*)

[2] *On the Edge of the Primeval Forest.* By Prof. Albert Schweitzer. Translated by Ch. Th. Campion. (A. and C. Black, Ltd., 6*s.*)

latter. "The Melanesians," as Mr. Durrad, who has served for many years in the Melanesian Mission on Torres and Banks Islands, points out, "are ignorant of the real objects of clothing, and seem to look on it more as a way of ornamenting the person than as anything else. . . . European clothes are unnecessary and are a source of disease. Moreover, they are worn without any system of consistency. A man will wear, perhaps, a flimsy loin-cloth and a hat. Another day, a warmer one, he may appear in a shirt in addition. On yet another occasion one sees him in a pair of trousers only; or, again, in trousers and waistcoat. Or, if a full-blooded indentured workman, he appears garbed in trousers, shirt, possibly also a vest, a dungaree jacket, and a hat. . . . The women wear several layers of skirts and often a sort of short bodice. As a skirt becomes ragged another is superimposed, while the rags beneath gradually rot off. Clothes are worn till they cease to exist as recognisable garments." Such descriptions make amusing enough reading, but the effects of these practices are disastrous on islands where dampness prevails for long periods of the year. The recruiting of labour by planters, which is nowadays carried out voluntarily (except that "Frenchmen at times use violence and craft to get recruits"), takes men and women away from their tribes at the time of life when they should be producing children, and for this reason alone is one of the largest causes of depopulation. Moreover, numbers of them never return. This is especially the case with the Torres Islanders, who are enticed to go to plantations in the Southern New Hebrides. "Kept in debt by their French masters or tempted by alcohol, they are tied and bound for term after term of service and can rarely get free from the bonds which hold them." Perhaps more important than all is the psychological effect of this prolonged absence from their homes, which sends them back only to be discontented with their old surroundings after tasting the pleasures of civilisation, and eventually to become a discordant and revolutionary element in the communal life.

* * * * *

Here we come to what the late Dr. Rivers considered the most potent agent in the downfall of these races—the psychological changes which we have not been able to prevent ourselves from forcing upon them, or have forced upon them unwittingly, in the past. "When Melanesia became subject to Europeans, magistrates and missionaries were sent to rule and direct the lives of the people. They found in existence a number of institutions and customs which were, or seemed to them to be, contrary to the principles of morality. Such customs were usually forbidden without any inquiry into their real nature, without knowledge of the part they took in native life, and without any attempt to discriminate between their good and bad elements." The sudden stopping of head-hunting in the Solomon Islands left so great a gap in the daily interests of the natives that they very speedily lost their virility. The discouragement by missionaries in Fiji of the custom (which seemed to them incompatible with the ideals of the Christian family) by which men and women slept in different quarters, led to too free intercourse between the sexes. Again, in the New Hebrides a "highly complicated organisation arising out of beliefs connected with the cult of dead ancestors" was put an end to with disastrous results, in that it formed a highly important part of the social and economic life of the people. These and many other factors have brought about a loss of interest in life amongst the islanders which, as the late Dr. Rivers has indicated, has sapped their vitality and been both a direct and indirect influence in the process of depopulation.

* * * * *

Professor Schweitzer has come to such similar conclusions on the problem of the relationships betweeen the white and black races in Equatorial Africa that there is no need to enumerate them. Neither book is essentially pessimistic. The outlook is bad, but not hopeless. Where Christianity has, for instance, been carefully fostered in Melanesia so that it has not at once destroyed the old religious traditions and ceremonial, the people have embraced it with enthusiasm and have regained, and even increased, their vitality. In Africa, too, similar results have been obtained.

Yet we have to face the facts and to realise that the first shock of a far-advanced civilisation on primitive and semi-primitive races is so great and destructive, unless carefully regulated, that it may result in complete annihilation, let alone demoralisation. The history of the world may be broadly viewed as a series of these shocks, of these tides of superior civilisations sweeping over and obliterating inferior ones. But we hope that the time has at last come when a superior civilisation will find means of curbing its destructiveness. Some of the measures recommended by these books are: a careful study by officials, missionaries, traders and residents, of the customs of the natives, a gradual bringing into harmony of native customs with European customs and Christianity, financial encouragement of birth-production, more systematic medical research and service, an encouragement of interest in the economic life of the community, the realisation by the white man that natives of tropical countries cannot be overworked with impunity. To sum up in the words of the late Dr. Rivers, "something must be done, and done quickly, to give *the native* that renewed interest in life to which the health of peoples is mainly due."

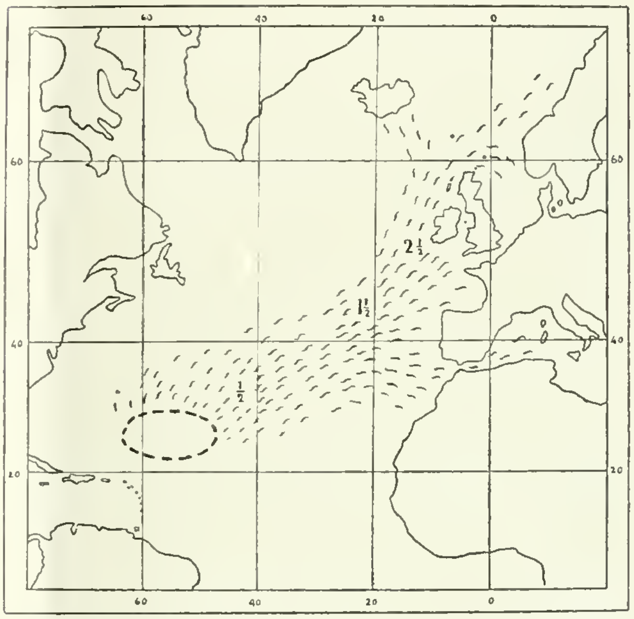
The Migrations of the Eel

By G. P. Farran

In a paper recently published in the *Transactions of the Royal Society of London*, Dr. Johs. Schmidt, the Danish zoologist, has given us almost the last word in the answer to the riddle: "Where do eels come from?" which for some thousands of years has excited the curiosity of mankind. Strange as have been the theories put forward from the time of Aristotle to the present day, the truth as disclosed by Dr. Schmidt is no less strange.

Curious ribbon-like fishes, about 2½ in. long, clear as glass, with pointed head and tail and opaque silvery eyes, to which the name of *Leptocephali* has been given, have long been known in the Straits of Messina, where they were brought to the surface in considerable numbers by ascending currents and whirlpools. These fishes came in time to be regarded as the larvæ of eel-like fishes (abnormal forms according to one school of thought), but it was not until 1893 that the Italians Grassi and Calandruccio, as recorded by the former in a paper, also read before the Royal Society, definitely recognised, by rearing it through its later stages, that the form known as *Leptocephalus brevirostris* was in reality the larva of the common eel. It was at this stage in our knowledge of the eel that Dr. Schmidt started his work by the capture, to the west of the Faeroes, in May 1904, of the first specimen of *Leptocephalus brevirostris* known in the Atlantic. A second specimen, as Dr. Schmidt records, was taken three months later off the west coast of Ireland by the Irish fishery cruiser *Helga*.

We may here review briefly what is known of the eel during its sojourn in fresh water. The eel, when feeding and growing, is characterised by its greenish back, yellow belly, broad head, and small eyes. Formerly in this stage it was regarded as a distinct species, and was called the frog-mouthed eel or yellow eel. When the adult or migrating stage approaches, which may be reached by females after a stay in fresh water of from five to twenty years, with a length of, usually, from 2 to 3 ft., and by the much smaller males after five or six years, with a length of not more than 20 in., a change begins to show itself. The powerful jaw muscles, which gave the head its broad appearance, begin to shrink. The head gets more pointed, the eyes increase in size, and the yellow colour changes to silvery, the eel thus becoming what is known to fishermen as the sharp-nosed eel or silver eel. With this change of form and colour the reproductive organs begin to develop, and the eels start on their journey seawards in autumn and winter. From the pools and lakes of all the countries of Europe they make their way downwards by streams to the larger rivers, and thence to the sea, resting by day and travelling by night, the principal runs taking place on dark moonless nights. This is the season when a heavy toll is taken of them by fishermen at the eel weirs with nets or traps set with their mouths pointing up-stream. In the countries bordering on the Baltic, especially in Germany, Denmark, and southern Sweden, the migrating eels, after they have reached the sea and are making their way along the coast towards the entrance of the Baltic, are taken in large numbers in traps set along the shore. Professor Petersen states that there are no less than 22,608 of these traps on the Baltic coast of Denmark.



DIAGRAMMATIC CHART SHOWING THE BREEDING PLACE OF THE EUROPEAN EEL, AND THE AGE IN YEARS OF THE LARVÆ AT DIFFERENT STAGES OF THEIR JOURNEY TO THE EUROPEAN COAST.

From marking experiments the rate of travel of these coasting eels has been estimated at about ten miles a day.

On its arrival at the open sea we lose sight of the migrating eel, which never returns. It is true that a few chance specimens have been taken, one in a trawl net near the mouth of the English Channel, another in the stomach of a cachalot in the Atlantic, and others in the Mediterranean, either taken from the stomachs of sword-fishes or brought to the surface by the whirlpools of Messina; but detailed knowledge of how they travel, whether in mid-water or along the bottom, and what they feed on, if they feed at all, is still lacking. These eels from the ocean show a

further change. The sexual organs, though not fully matured, have greatly developed, and the eyes have increased to an immense size.

After the departure of the full-grown eels, the next thing that the observer on shore sees is the arrival from the sea of the young transparent glassy elvers, or young eels, of about $2\frac{3}{4}$ in. in length. The earliest arrivals reach the rivers of the west coast of Ireland and the north coast of Spain in November and December. They appear in the Loire in January, in the Seine in February, and do not reach the Danish coast till April.

The passage of the elvers up some of our larger rivers has often been described. They pass up in a steady, continuous stream, heads almost touching tails, in a broad band, surmounting rapids and falls and other dangerous obstacles by scrambling up damp rocks or over weirs.

At Epney-on-Severn, an old-established elver fishery, organised by a German fishery association in 1908 for the purpose of stocking the less favourably situated waters of Germany, and subsequently taken over by the Ministry of Agriculture and Fisheries, serves as a distributing centre for supplying elvers to lakes and rivers of the British Isles whose natural supply is deficient. At this fishery the runs of elvers occur at the flood of the spring tides of April and May, the fishing being done chiefly at night by means of a hand net.

Many elvers remain for a considerable time in salt water, lurking under stones on the shore, before starting their journey inland. By about April the elvers become pigmented and opaque, whether they have ascended a river or are still in the sea, and feeding and consequent growth, which had ceased during the last ten months of their larval life, are again resumed.

After the capture of the Leptocephalid larvæ in the Atlantic in 1904, as mentioned above, Dr. Schmidt began a systematic search for others which, he argued, must be present in immense numbers if only he could find the right locality. Working southwards from off the Hebrides in June 1905, along the edge of the deep water of the Atlantic, he found the larvæ in increasing numbers till they reached a maximum off the south-west coast of Ireland, over a depth of about 500 fathoms. These specimens measured from 60 to 88 mm., with an average size of 75 mm., or 3 in., and were similar to, but slightly larger than, those which had been found in the Mediterranean—thin transparent lanceolate creatures, with small heads and mouths, well furnished with fine teeth.

Still seeking for the younger stages, Dr. Schmidt pushed his researches farther out into the Atlantic. Mainly with the aid of collections made by himself in the schooners *Margarethe* and *Dana*, and with over 500 gatherings made for him on board the ships of various Danish shipping companies, he has traced the *Leptocephali* westwards and southwards back across the Atlantic, finding them ever smaller in size, but more numerous and spread over a smaller area. In mid-Atlantic, in June, the *Leptocephali* had an average length of 52 mm., or about 2 in., and still farther to the westward, also in June, a third group was encountered which had an average length of 1 in. The smallest sizes were found to be concentrated in a comparatively small area, stretching from 22° N. to 30° N. and from 48° W. to 65° W. Within this area, and nowhere else in the North Atlantic, larvæ of $\frac{2}{5}$ in. or less were found in considerable numbers. Here at last, about 2,500 miles from the mouth of the English Channel, and 500 miles north-east of the Leeward Islands, was the breeding place of the eel. Here (to quote the summary which Dr. Schmidt gives in his paper) "spawning takes place in early spring, lasting well on to summer. The tiny larvæ, 7 to 15 mm., float in water layers about 200 to 300 m. (110 to 160 fathoms) from the surface in a temperature of about 20° C. The larvæ grow rapidly, and in the first summer average about 25 mm. They now move up into the upper layers, the great majority being found between 25 and 50 m. (14 to 28 fathoms), or at times even at the surface. During the first summer they are to be found west of 50° W. By the second summer they have attained an average length of 50 to 55 mm., and the bulk are now in the central Atlantic. By the third summer they have arrived off the coastal banks of Europe, averaging 75 mm., but retaining the compressed leaf-like form. In autumn and winter they undergo a retrograde change which brings them to the shape of young eels."

From the time they reach the fully developed larval form in June till the pigmented elver stage is reached nearly a year later, the young eels apparently take no food; at any rate none has been found in the stomach or gut, and the energy for the journey from the Atlantic to fresh water is derived from its reduction in size.

But the mystery of the eel was not yet fully cleared up. There is an American eel (*Anguilla rostrata*) which, but for the fortunate chance that it has a smaller number of vertebræ, from 105 to 111, could hardly be distinguished from the European species, which has from 111 to 119. The larval forms can be separated in the same way, since the myomeres or muscle segments, which can be counted in the larvæ, correspond in number to the vertebræ. In the western part of the breeding area of the European eel the earliest larval stages of the American eel were found in considerable numbers, both species being sometimes taken in the same net. The question then

arose: Why do not the American larvæ make their way to Europe and the European to America? To this riddle, too, Dr. Schmidt has furnished an answer. Tracing the larvæ of the American eel westwards and northwards, he found that the larval stage, which lasts for three years in the European species, is passed through in one year, the elver being then ready to enter fresh water. Consequently, if an American larva should join the current setting for the coasts of Europe, he would find himself in mid-Atlantic at the time when the period for river life arrived, and thus would come to an untimely end. On the other hand, should a European larva be carried to the north-west, he would arrive at the coast with two years of pelagic life still before him, and he too would perish.

Dr. Schmidt, not content with these discoveries, is now completing yet another Atlantic cruise in the new Danish exploring steamer *Dana* with the object of clearing up any points which still remain obscure in the life-history of the eel and, if possible, finding and hatching out its egg, thus completing what is probably one of the most remarkable investigations in marine zoology ever undertaken.

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The Sacred Mountain of Pangæum

By Stanley Casson, M.A.

Fellow of New College, Oxford

For a variety of reasons it has come about that the north coast of the Ægean Sea is the least explored part of the European shores of the Mediterranean. From prehistoric times until to-day armies have marched and invading hordes have passed from east to west and west to east along the great highway that stretches from Constantinople to the Adriatic, along this North Ægean shore. As each invader or conqueror appeared, the native population was either displaced or else took to the hills and waited until the trouble had passed. The great movements of peoples from Central Europe to the South and East which took place in prehistoric times at the close of the Bronze Age were deflected southwards into Greece and eastwards into Asia Minor when they reached the sea-coast between Olympus and the Dardanelles. Tribe after tribe moved along the northern coast road, and the remnants of the earlier peoples took to the hills and fastnesses of the mountain ranges that fringe the coast.

Later, in historic times, there came first Megabazus the Persian on a punitive expedition for his master Darius in 513 B.C., and then Xerxes in 481 B.C. Again the native peoples took to the hills; but this time the more disciplined forces of Persia subdued all of them except the tribesmen who had fled to the remoter highlands of the upper Strymon, and the Satræ and Bessi, who lived on the summits of Pangæum. Later still, in 168 B.C., Æmilius Paullus, conquering for Rome, found that there were still many tribes to subdue, and did little but cut an avenue of peace through a forest of savagery. Then later came the Turk, and with him alternating revolt and massacre. Armies of Bulgars, Turks, Greeks, and Serbs have never ceased to move eastwards and westwards along this troubled coast, and still to-day more armies come and go, and peace, that has never yet come to this land, seems as far off as ever. Therefore in antiquity the native peoples lived a semi-nomad life among the hills and the Greek colonists lived along the coast. Each could thus escape the attacks of the other more easily, or equally well of any third party who, as invader, would find the natives inaccessible and the Greeks defended by walls and supplied by sea. Similarly to-day the most flourishing villages exist either along the coast or against the mountains, the latter usually at the entrances of ravines that open a way of refuge to the highlands. Seres, Demir-Hissar, Poroi in the Struma valley, and all the villages on the north side of the plain of Drama, are so situated at the very roots of the hills at the entrance of ravines or clefts. So, too, with Xanthi in western Thrace and with the numerous villages that form a ring right round the foot of Pangæum. The inhabitants could thus escape at a moment's notice and return when the danger had passed, to find their villages sometimes in ashes and sometimes untouched.

So recurrent have been the wars, massacres, deportations, and migrations even in recent times in these regions that little scientific exploration has been possible. A succession of travellers has passed across the Macedonian and Thracian coast, but few have halted and scarcely any have left the beaten track—the old coast road—to explore the highlands on the north or the Greek coast towns on the south. Cyriac of Ancona,[1] in the fifteenth century, passed only along

[1] The MSS. of Cyriac are in the Laurentian Library at Florence.

the high-road. Pierre Belon [1] in the sixteenth and Paul Lucas [2] in the seventeenth century did little more. Cousinèry [3] alone of the nineteenth-century travellers explored extensively and thoroughly: this he could do by virtue of his long residence and his position as Consul of France at Salonika. But he says little or nothing of Pangæum. Leake,[4] whose researches in northern Greece, as in southern Greece, are marked by the ablest scholarship and accuracy and by the most acute judgment, has left a most complete account of western and part of eastern Macedonia; but his travels, which were to have been continued eastwards, were brought to an abrupt conclusion by the outbreak of war between England and Turkey in 1807, and he never

FIG. 1.—THE SUMMIT OF MOUNT PANGÆUM AS SEEN FROM THE SOUTH-EAST.

reached farther east than the Struma valley. Later in the same century the mission sent by the French Government under Heuzey and Daumet [5] carried out some detailed surveys and archæological exploration as far as the plain of Drama, but the east was still untouched and no attempt was made to investigate Pangæum and its problems. Later still two Greeks explored the Pangæan district—Chrysochoos [6] and Mertzides,[7] the former a cartographer, the latter a doctor who lived in Thasos. But Chrysochoos, whose work is able and important, produced no map of the Pangæan area, and Mertzides, who is the only writer to leave an account of an ascent of Pangæum, is brief and unilluminating. Perdrizet,[8] a French scholar, is the only writer of the present century who has made a serious study of Pangæum and the Pangæan area. His work has done much to raise the many historical and archæological problems involved.

Thus it has come about that Mount Pangæum, although distant only a seven-days' journey from London, remains one of the least-known parts of Greece. That it is worth exploration is sufficiently evident from the fact that in antiquity it was a refuge for the most warlike and unsubduable tribes of Thrace; that it was the greatest and most sacred centre in Greece for the worship of Dionysus, holding, as it did, the famous Oracle of Dionysus; and, finally, that it was the centre of the gold and silver mining of Thrace, which had provided the sinews of war successively to Peisistratus and Aristagoras in the sixth century B.C., to Athens and the Athenian Confederacy in the fifth and to Philip of Macedon and Alexander in the fourth. In fact the very foundations of the Macedonian kingdom that Philip founded were laid on the increased revenue that he derived from the mines of Philippi at the foot of Pangæum.

Before 1912, when the whole region was part of Turkey in Europe, both the difficulties put in the way of travellers by the Turkish authorities and the dangers of leaving the beaten track made the whole region most difficult of access. From 1912 to 1914 the first and second Balkan wars involved the whole district in military upheaval. From 1915 to 1918 it fell into the area occupied by the forces of Bulgaria. Only now is it accessible in safety to the traveller. I found no difficulty in visiting the remoter villages of the plain and the mountain itself during the course of the spring of this year.

Mount Pangæum rises abruptly out of the flat and prosperous plain of Drama, and reaches a height of 6,142 ft. above the sea level. The eastern side of the plain is covered by a vast malarial swamp, which cannot be drained into the sea because of the low barrier of hills at the southern end that divide it from Kavalla and the coast. A certain amount of the overflow reaches Lake Tahinos in the Struma valley by way of the River Angista, but a large part of the plain is rendered useless for agriculture. It seems improbable that the swamp was so extensive in Roman times, for the site of Philippi is to-day almost under water. But if the Romans had drained the water into the sea, no trace of their workings has yet been found.[9] Above the plain the mountain rises in fine and shapely outlines, snow-capped for all except the summer months. The north side is bare, treeless, and unbroken by ravines. On the south and east it falls away in a series of enormous hollows that are filled with forests of beech and oak

[1] *Les Observations de plusieurs singularitez et choses memorables trouvées en Grèce.* (Paris, 1554.)

[2] *Voyage au Lévant* (La Haye, 1705), and *Voyage dans la Grèce* (Amsterdam, 1714).

[3] *Voyage dans la Macédoine.* (Paris, 1831.)

[4] *Travels in Northern Greece.* (London, 1835.)

[5] *Mission Archéologique de Macédoine.* (Paris, 1876.)

[6] Various articles in the Ἐπετηρὶς τοῦ Παρνασσοῦ, 1898, 1900, etc.

[7] *Οἱ Φιλίπποι.* (Constantinople, 1897.)

[8] *Les cultes du Pangée* (Nancy, 1912), and an article, "Scaptesyle," in *Klio*, x, pp. 1–27.

[9] A British company has now undertaken the drainage of the plain.

and, in the higher parts, of larch. The lower parts of the mountain are of crystalline limestone ; the summit is of pure white marble, with a thick grain similar to, and almost indistinguishable from, that of Parian. The ascent of the mountain, which requires two days, is best made from the village of Banitsa on the north side. Thence a path leads to the monastery of Eikosiphoinissis, which is built in a wooded hollow at a height of 1,200 ft., and overhangs the village of Nikisian on the east side. This monastery was built between the years A.D. 443 and 454, in the time of Sozon, Metropolitan of Philippi. A pure and plentiful spring flows out here and is said to have appeared at the founding of the monastery. From here the path ascends steeply along a ridge on the south-east face of Amphipolis and the line of the river clear and distinct. From the summit the same path is said to run on down the west slopes of the mountain straight into Amphipolis. Near the summit is another cave, small and shallow, known as Chionistra, and in it snow lies unmelted all the summer.

The villagers of Pangæum say that there are traces of old mine workings on the summit near Chionistra, on the lower southern slopes above Nikisian, and at a place near the village of Mosorop known as Asimotripi, or "Silver Holes."

Pangæum is known to the Turks as Pilaf Tepe, the "Hill of Rice," because of its snowy cone-shaped summit ; or Pirnar Dagh, because of the spring at the monastery. By the Bulgars it is called Gushnitsa.

FIG. 2.—THE MONASTERY OF EIKOSIPHOINISSIS.

and passes an enormous cave known locally as Ascetotripo, or "Monk's Hole." The full extent of this cave I was not able to ascertain, but there were at least three large chambers in succession leading into the heart of the mountain. Beyond the cave is a wide extent of beech forest, the floor of which, in April, was covered in the more open parts with cowslips and wild lilies-of-the-valley, and on the outskirts of the trees with peonies and wild roses. The forest came to an abrupt end just below the snow-line, and the path emerged into a steep ascent known as Scala Denas. Perhaps in this name we can see a survival of the name of Dionysus, which is not otherwise preserved in the district. In and round the snow was a profusion of crocus, squill, and grape-hyacinth. The path to the summit bends round the northern face and commands a view of the whole of the Struma valley, with the site

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The Greeks retain or have revived the ancient name.

Where, then, were the gold and silver mines of antiquity and where was the Oracle of Dionysus ? Where did the tribes of Satræ and their priests of the Bessi tribe live, the people whom Herodotus says were never subdued by any man ?

The main problem of the gold and silver of Pangæum has yet to be solved. The problem, generally stated, is this. Mount Pangæum or the Pangæan area, that is to say, the mountain together with the Drama plain to the east, the Angista valley to the north, the lower part of the Struma valley on the left bank of the river to the west, and the rugged coast at the foot of the mountain on the south, is fixed by innumerable references in ancient authors as the greatest and most important mining area of the eastern Mediter-

ranean in ancient times. Our only evidence for the existence of mines on the mountain itself is Herodotus,[1] who says that Pangæum is "a large and high mountain in which there are mines of gold and silver. It is inhabited by the Pierians and Odomanti and principally by the Satræ." Euripides, in the *Rhesus*,[2] calls Pangæum "silver-bearing," and again the "gold-ored cliff Pangæum."[3] Strabo and other authors follow suit, and the general impression is given that the mountain itself was the main source of supply of the gold and silver of the area. But, on the other hand, all the most famous mines of the Pangæan area are not on the mountain. Scaptesyle, the most famous, the mine from which the historian Thucydides derived his wealth, acquired as the dowry of his Thracian wife, seems to have been on the coast. Stephen of Byzantium, in his treatise *Concerning Cities*, states clearly that the town of Scaptesyle was opposite Thasos. Herodotus[4] mentions the Συλέος Πεδίον, which was near the mouth of the Struma, a place-name which may be connected with the name of the mine. Perdrizet,[5] who suggests that this mine was situated near the site of the present monastery of Eikosiphoinissis, can adduce no ancient evidence to support his view, and I was unable to find any trace of ancient workings at or near the monastery.

The mine called Asyla,[6] which brought Philip of Macedon his revenue, was in the plain near Crenides or Philippi, as that town was subsequently called. The island of Thasos, which also contained rich mines, falls geologically into the Pangæan area. The Thasians owned other mines on the mainland, but we are nowhere told that these were on the mountain itself. There is an issue of gold coins inscribed with the name of the "Thasians of the mainland" which was probably struck from the gold of these mines. Where, then, were the mines of the mountain?

In view of the fact that workings only of unimportant character and insignificant size have been found on the mountain itself, it seems unlikely that it was ever mined to a very large extent or that it was ever very productive to the direct operations of the miner. This seems borne out by the formation of the mountain, which is not of so metalliferous a nature in its upper levels as in its lower.

The whole question, however, of the nature of ancient gold and silver working is raised. Did the ancients understand how to extract gold from ore, or was ancient gold-mining confined to the collection of surface and alluvial gold? In the case of silver the process of extraction from galena ores was simpler and certainly understood in antiquity up to a point, as the remains of the silver workings at Laurium in Attica indicate.

Perdrizet is of opinion that, in the Pangæan area at any rate, only alluvial gold or "placer" gold, as miners call it, was collected, and that the almost complete absence of gold in the Pangæan district to-day is accounted for by the fact that the "placers," as is invariably the case, became exhausted, and that, too, at an early date in antiquity. Certainly we hear little of Pangæan gold in Roman times. Even in the fifth and fourth centuries B.C. "placer" succeeded "placer," and while Scaptesyle was the popular centre in the fifth, so Asyla replaced it in the fourth century. Certainly Perdrizet's view is borne out by Strabo,[7] who says that "the peasants who plough the land in Pæonia are said to find nuggets of gold." This can only refer to alluvial gold.

Whether Perdrizet is right in his further assumption that the ancient world in general knew only of mining for alluvial gold is uncertain. There are many passages in ancient authors which seem to contradict this. In any case we must await the discovery of more ancient gold workings before we can accept such a generalisation. Neither Scaptesyle nor Asyla has yet been identified, chiefly, perhaps, because no one has yet set out to look for them according to the indications left by ancient authorities.

In general it seems probable that the mountain itself contained little gold that was accessible. On the other hand, from the veins and deposits that it contained, it is most likely that gold had been washed by constant erosion and deposited in the earth of the extensive plains at its foot by way of the numerous ravines that drain its sides. This was the Pangæan gold that was collected by the miners. The few workings on the mountain itself were probably undertaken, for the most part, to obtain silver, while the pyrites deposits were worked tentatively and unsuccessfully.

Of the Oracle of Dionysus we know all too little. What we do know is given by Herodotus and Euripides and in a few other occasional references. Herodotus[8] says that:

"These are the people [the Satræ] who possess the Oracle of Dionysus, which is on their most lofty mountains. Of the Satræ, those who act as prophets of the shrine are the Bessi; a prophetess gives the oracles as at Delphi."

Euripides in his play, the *Rhesus* is vague. Rhesus, after his death, is said to live beneath the mountain as a semi-human deity (*anthropodæmon*), who served Dionysus as prophet. This has been taken to indicate that the Oracle of Dionysus was in a cave. According to the words of Herodotus quoted above, the

[1] vii. 112. [2] l. 970.
[3] l. 921. [4] vii. 115. [5] *Klio*, x, p. 26.
[6] Appian, *Bell. Civ.*, iv. 106.

[7] Frag. 35. [8] vii. 111.

Oracle was in the more inaccessible parts of the mountain and not in the plain, for it was guarded by the Satræ and Bessi, wild mountaineers, whose peculiar charge it was. Pangæum was inhabited "principally by the Satræ," he says in a passage already quoted.

No remains of a building which can be identified with the Oracle have yet been found on the mountain, which is remarkable for the almost entire absence of signs of ancient habitation. It must be presumed that so savage and primitive a people as the Satræ controlled an oracle that was of a simple and elementary nature. It is generally believed now that the Satyrs of ancient mythology, who are the semi-human attendants of Dionysus, are to be derived by way of legend and art from these wild people of Pangæum. Their name itself seems to be the same. In the same way the ogres of fairy-stories are said to originate from some half-forgotten folk-memory of Palæolithic cave-men, and dwarfs and gnomes from old half-legendary people, as, for instance, the Picts.

So we shall probably not be far wrong in looking for the famous Oracle in some cave on Pangæum, possibly in the cave of Ascetotripo. Nothing to suggest the certainty of such an identification was visible in the cave when I saw it, but the accumulations of ages and the constant deposit of calcareous matter had rendered an examination of the soil impossible. The difficulty was increased by the depth and darkness of the cave. Only by excavation will it be possible to find out the purpose of the cave and the traces of its inhabitants. Few caves in Greece are empty of all traces of habitation, and many are sanctuaries. The Dictæan and Kamares caves in Crete and the caves of Pan on Hymettus and Parnes in Attica have all given up a rich store of antiquities to the excavator, and it is not unreasonable to hope for interesting discoveries from this Pangæan cave.

Of the Bessi, who seem to have been the sacred caste of the worshippers of Dionysus, we know more than of the Satræ. The tribe of Bessi is frequently mentioned throughout history from the time of Herodotus to the Christian era. "All these tribes," says Strabo,[1] speaking of the tribes of Thrace, "are most addicted to brigandage, but the Bessi, who for the most part live in Hæmus [i.e. the northern part of the Balkans], are called brigands even by brigands." It seems to have been a detachment or special caste of these Bessi of Hæmus who served Dionysus on Pangæum away from their northern home. Persian, Greek, and Roman alike left them unsubdued. As each invader came across the plains, they descended from the mountains, attacked his troops and transport, and withdrew unbeaten. Only in the Christian era are they said at last to have been led into the path of respectability. In the fourth century A.D. Bishop Nikitas of Dacia claims to have converted them: they are made the subject of a poem or congratulatory ode written to the bishop by his friend Paulinus[2]:

[1] Ch. 318.

> Hard were their lands and hard those Bessi bold,
> Cold were their snows, their hearts than snow more cold;
> Sheep in the fold from roaming now they cease,
> Thy fold of Peace.

That the Satræ of Pangæum and the Satyrs of Dionysus are both the true natives of the mountain seems clear. All the beautiful silver coins of the towns and tribes in the immediate vicinity bear as types fantastic satyrs in a variety of attitudes and occupations. With them on many coins are nymphs, usually in the rôle of reluctant or protesting captives. There were no nymphs on Pangæum, and the Satyrs, like the savage mountain tribe that they were, raided the villages of the plain.

Such are the problems that cluster round the sacred mountain of Pangæum. Little has yet been found out and much remains to be done. It is no mere coincidence that Athos, the sacred mountain of Orthodox Christianity, rises to the south in Chalcidice and, towering higher than Pangæum, throws a challenge to the most pagan shrine of Paganism. Its status as a republic throughout the Turkish domination and its accessibility to travellers have made it known to the world just as Pangæum has remained unknown. While Athos has always been a refuge for the oppressed or ascetic Christian, Pangæum has never been more than a refuge for unruly tribesmen and, in more recent times, for brigands and outlaws who wished to escape the tax-collector, the army, and the police of the various races which have from time to time controlled this wild and barren coast.

The clue to much history lies in these northern provinces. To Athens in the fifth century Thrace and Macedonia meant as much as, and more than, they had been to the adventurers in the sixth. Her empire might have been consolidated and her wealth assured if she had concentrated all her efforts towards strengthening the bonds between herself and the Greek cities of the coast and towards increasing the influence she already possessed with the princes of Thrace and Macedonia. But she was induced to dissipate her strength in more distant regions, and to abandon any projects she may have formed for development in the north.

[2] Translated by J. Harrison in *Prolegomena to the Study of Greek Religion*, p. 371. There are three more verses.

The First Voyage Round the World

By R. T. Clark, M.A.

Four hundred years ago, on September 6, a tiny ship of eighty-five tons cast anchor outside Seville Bay. She was much battered and damaged, her sails were patched and her ensign torn; but she could look down with pride upon the statelier galleons that passed her, for she had accomplished what no other ship had accomplished before her—the circumnavigation of the globe. Partly because of a certain absence of that dramatic element which surrounds the voyage of Columbus, partly because, no adequate record of it having been preserved, no historian has thought it worth while to make Magellan as famous as Columbus or Vasco di Gama, or even Cortez and Pizarro, and partly on account of national jealousy and over-patriotic historians, the man whose enterprise was, in Lord Stanley's words, "the greatest ever undertaken by any navigator" [1] is almost the least known of the great explorers.

Magellan, or, to give him his full name, Fernao de Magalhaes, was a Portuguese—the Spanish historians have never forgiven him for it—and was originally in Portuguese service in the Indies, where he greatly distinguished himself for personal courage and resource and was "always much wounded"; but, venturing to differ from the Governor, the imperious Albuquerque, fell from favour, and was refused employment at sea. On this he denationalised himself and became a Spanish subject—the Portuguese historians have never forgiven him for that—and succeeded in interesting Charles V in a project to reach the El Dorado of the Indies from the west to the great detriment of the Portuguese and the greater glory of the King of Spain. The royal interest was fruitful of result. On May 4, 1518, Charles signed a contract with Magellan by which five ships were placed at his disposal and an expedition prepared despite the protests of the King of Portugal.

On August 10, 1519, Magellan set sail with his little fleet, the *Conception* (90 tons), the *Victoria* (85 tons), the *San Antonio* (120 tons), the *Trinity* (110 tons), and the *Santiago* (75 tons).

"The ships of Magellan's fleet, Sire," reported the agent [2] of the Portuguese king to his anxious master, "are five. . . . They are very old and patched up: for I saw them when they were beached for repairs. It is eleven months since they were repaired, and they are now afloat and they are caulking them in the water. I went on board of them a few times and I assure your Highness that I should be ill inclined to sail in them to the Canaries because their knees are of touchwood. The artillery which they all carry are eighty guns, of a very small size: only in the largest ship, in which Magellan is, there are four very good iron cannon. All the crews they take, in all the five vessels, are 230 men, and they carry provisions for two years."

And so the King of Portugal was comforted, and concluded that with such an armament there could be no real threat to his possessions in the East.

Magellan had no historian with him; he was no writer himself, and if it had not been that there chanced to be on board two Italians, one anonymous but commendably concise, the other the Chevalier Antonio Pigafetta, gratefully loquacious, we should know next to nothing of the epic voyage. But from their narratives and a few supplementary documents it is possible to gather the events, if not the spirit, of it with tolerable accuracy. Passing Teneriffe and the Cape Verde Islands, Magellan struck south-west for the Brazilian coast, which he reached in December in the neighbourhood of Rio. Thence he proceeded down the coast in search of the desired channel that would take him to the East by way of the West. They passed the La Plata, and baptised it the river of St. Christopher and found delight—or rather the Vicenzan, Pigafetta, did—in the sights and sounds of Patagonia and its natives with their areca nut, their cannibal habits, and their great god Setebos, who took Shakespeare's [3] fancy as well as Pigafetta's. They even made friends with these tall savages and baptised them, having special fondness for an immense gentleman "so tall that the tallest of us only came up to his waist," whom they called John, and who "when he leapt caused the earth to sink in a palm depth at the place where his feet touched," and who "pronounced the name of Jesus, the Pater Noster, Ave Maria, and his name as clearly as we did; but he had a terribly strong and loud voice." [4]

They were now in unfamiliar and hostile waters made memorable and terrifying by previous disasters, and daily penetrating farther into the unknown Antarctic and the storms of the Horn. The strain began inevitably to tell on the crews. Few of them had any sense of loyalty to Magellan or sympathy with his enterprise, for already off Teneriffe there had been mutterings of mutiny. As Spaniards they disliked being commanded by a Portuguese, and, as few of them seem to have been of the stuff of which pioneers are made, they disliked still more the idea of being led to a miserable end in the frozen south. When they reached the "port of St. Julian" on the verge of the mysterious Antarctic, matters came to a crisis. Headed by three Spanish captains the malcontents

[1] Stanley (vide note on references at end of article).

[2] Ibid., p. 42.

[3] Ibid., p. 55. Cf. *The Tempest.*

[4] Ibid., p. 52.

"rose up against the Captain Major, the captains saying that they intended to take him to Castile in arrest, as he was taking them all to destruction." [1]

If they thought to terrify a veteran who had braved governors and faced perils in those very Indies which he was determined to reach, they sadly misjudged their man. With the help of some faithful Portuguese and other "foreigners," and the men of his own ship, Magellan had one of the leaders killed out of hand; five days later another was beheaded and quartered, and the remainder found it prudent to acquire new enthusiasm for exploration. That trouble over, Magellan prepared to continue his voyage, but had to face another mishap, as the *Santiago*, sent to explore the coast, went on the rocks, and her crew escaped only with great difficulty. Thus reduced in number, they at length got clear of St. Julian on August 24, 1520, after having "set up at the top of the highest mountain which was there a very large cross, as a sign that the country belonged to the King of Spain and given to the mountain the name of Mount of Christ," and after all had "confessed and received the body of our Lord like good Christians." [2]

Thus prepared for the worst, the little fleet crept slowly down towards the Horn. On October 21 they arrived off a cape, which for the sake of the day they named the Cape of the Eleven Thousand Virgins. After sailing two or three leagues onwards, they found themselves at the mouth of a strait, and here amid much excitement they anchored.

An exploring party sent out reported that there were three channels. The fleet moved up to where the channels separated and again cast anchor. The *San Antonio* and *Conception* were sent on to search the channels, but in the darkness the crew of the *San Antonio* mutinied, flung their commander, Alvar de Meschite, Magellan's cousin, into chains, and, slipping past the others, made incontinently for Spain. The *Conception*, missing her consort, fluttered aimlessly about until Magellan, receiving no word from either scout, came on himself, and, picking her up, pushed on through the channel till night fell, when he anchored again. He sent the boats out and followed with the ships, and the boats reported that there was an outlet, for they could see the great sea on the other side. Magellan immediately ordered all his artillery to be fired, and, amid rejoicings and congratulations, the three tiny vessels sailed proudly into the unsailed waters of the South Pacific.

The object of the journey had been attained. It had been proved that the American continent was not an insuperable barrier to ships sailing west; it remained to prove that there lay on its western shore no obstacle to prevent ships reaching the Indies. On the other side of the Straits of Magellan the fleet was in even more unfamiliar waters than when it was descending towards the Land of Fire. But success tells. The discovery of the south-west passage had vindicated the expedition's leader and justified all the risks he had taken. There was no more talk of mutiny as the three ships steered light-heartedly westward to widen the empire of the King of Spain, although their crews were to suffer hardships far greater than any they had suffered in the Atlantic.

November 28 saw them in the open sea, where they "remained three months and twenty days without taking in provisions or other refreshments, and we only ate old biscuit reduced to powder and full of grubs and stinking from the dirt the rats had made on it when eating the good biscuit, and we drank water that was yellow and stinking. We also ate the oxhides which were under the mainyard so that the yard should not break the rigging: they were very hard, and we left them for four or five days in the sea and then we put a little on the embers and so ate them: also the sawdust of wood and rats which cost half a crown each; moreover enough of them were not to be got." [3]

Nineteen of the crews died from scurvy, and over thirty were seriously ill during that run of 4,000 leagues before they touched land, for with singular ill-luck the route that Magellan believed led most quickly to the Indies took them out of sight of island after island of the Pacific archipelago. There might have been tempests and storms, but the ocean was rightly named, for they had good weather continuously until they struck land on January 24 in the Paumatu group. On March 6 they reached a group of islands whose people were "poor, ingenious, and great thieves," and they therefore named the group the Ladrones. Thence it was a straight run to the Philippines—the domain of the Portuguese monopolists. In the Philippines they made friends with the natives, for, after all, it was here that the commercial business of the voyage began, and on Cebu, where Magellan was so popular that "he did what he pleased with the consent of the country, in one day 800 people became Christian, on which account Magellan desired that other kings neighbours to Cebu's should become subject to him who had become Christian." [4]

The heathen, however, proved hard of heart, so Magellan proceeded to burn down their villages and then to demand war indemnities. Hardness of heart persisted, and when, on April 23, Magellan arrived with some fifty men to enforce his demand he found himself opposed by a force of about 4,000 savages. Nothing daunted, Magellan disembarked at daylight,

[1] Stanley (vide note on references at end of article), p. 3.
[2] Ibid., p. 57.
[3] Ibid., p. 64.
[4] Ibid., p. 12.

and, leaving a guard on his boats, advanced inland with forty-nine men, only to be attacked by 1,500 islanders in three squadrons, who assailed them on front and flank. Volleys from musketeers and crossbowmen did not stop the islanders, nor did a diversion in the form of an attempt to burn the villages succeed any better.

"They came down upon us with the greater fury. The captain had his right leg pierced by a poisoned arrow, on which account he gave orders to retreat by degrees. We were oppressed by the lances and stones the enemy hurled at us, and we could make no more resistance. Retreating little by little and still fighting, we had already got to the distance of a crossbow-shot from the shore, having the water to our knees, the islanders following and picking up the spears which they had already cast, and they threw the same spear five or six times: as they knew the captain, they aimed specially at him and twice they knocked the helmet off his head. He, with a few of us, like a good knight remained at his post without choosing to retreat further. Thus we fought for more than an hour, until an Indian succeeded in thrusting a cane lance into the captain's face. He then, being irritated, pierced the Indian's breast with his lance and left it in his body, and, trying to draw his sword, he was unable to draw it more than half-way on account of a javelin wound which he had received in the right arm. The enemies, seeing this, all rushed against him, and one of them with a great sword like a great scimetar gave him a great blow on the left leg which brought the captain down upon his face; then the Indians threw themselves upon him and ran him through with lances and scimetars so that they deprived of life our mirror, light, comfort, and true guide. . . . This fatal battle was fought on April 27, 1521, on a Saturday: a day which the captain had chosen himself because he had a special devotion to it."[1]

With great difficulty Pigafetta and the others, leaving the body of their leader in the hands of the enemy, managed to get back to their ships and the "Christian king" of Cebu with the sad news. The survivors, having with some difficulty and loss foiled a plan of the "Christian king" to exterminate the lot of them, left the scene of their disaster to sail on westwards. They were now too few to man three ships, so off Bohol they burned the *Conception*, and, having touched at Borneo, sailed over the Celebes Sea. On November 6 they sighted the Moluccas, the lure of which had drawn Magellan from Seville to his death, and "we gave thanks to God and to comfort ourselves discharged all our artillery. It need not cause wonder that we were so much rejoiced since we had passed twenty-seven months less two days always in search of Maluco, wandering for that object among the immense number of islands."[2]

They landed at Tidore, where they had hoped to find a Portuguese adventurer named Serrano, a relative of Magellan, whose letters had been one of the inspirations of the latter's quest; but he was already dead, a victim to native treachery. But they found a European, the Portuguese de Lorosa, who had helped to discover the islands ten years before and had taken upon himself the duty of trying to intercept and destroy Magellan's fleet ere it reached the Indies. This was a reminder that they were now in hostile waters, although the Portuguese were in no great strength east of Singapore. But west of that the enemy were both equipped and prepared, and they learned to their great apprehension that squadrons were cruising off the Indian coast and off the Cape of Good Hope with express instructions that none of the Spaniards who had sailed into the King of Portugal's waters were to be allowed to return to Spain. On December 11 they prepared to leave Tidore, but found that the *Trinity* had sprung a leak. So they left her there with her crew, and the tiny *Victoria*, the sole survivor, went on her lonely way. Past Timor they sailed, and, leaving Sumatra to the north, steered straight across the Indian Ocean towards the Cape of Good Hope. Long before the journey was accomplished the crew were in a parlous state. The ship was making water and the weather was bitterly cold, while they had nothing but rice and water for food. For nine weeks they remained off the Cape delayed by westerly gales, but at last on May 9, 1522, succeeded in rounding it, and then for two months sailed northwest. On July 9 they reached the Cape Verde Islands and had to touch at one of them, where they were amazed to discover, like Jules Verne's hero, that it was Thursday, while with them it was only Wednesday. At last, concludes Pigafetta, "on Saturday the 6th of September of the year 1522, we entered the bay of San Lucar and of the sixty men who composed our crew when we left Maluco we were reduced to only eighteen, and these for the most part sick."[3]

Thus ended the greatest voyage the world has ever seen—a voyage most of the incidents in which have been lost to history for want of an expert chronicler. Little, too, is known of its remarkable leader, and only at the end of recounting a great career does even

[1] Stanley (vide note on references at end of article), p. 101.

[2] Ibid., p. 124.

[3] Ibid., p. 162. Eighteen is Pigafetta's figure, but others who had been arrested by the Portuguese at Cape Verde returned later (vide Stanley, p. 175, and Markham, p. 25). The captain of the *Victoria* was a Spaniard, Juan Sebastian del Cano. He was originally master of the *Conception*, and took part in the mutiny at St. Julian. He was pardoned and was elected captain of the *Victoria* in the Philippines. He died on an expedition in 1526.

the loquacious Pigafetta break silence concerning the personality whom he obviously loved so well. Remembering that blood-stained beach he cannot restrain himself, but breaks off his narrative to address himself directly to his patron, the famous Grand Master of Rhodes, Villiers de l'Isle Adam :

"He died: but I hope your illustrious Highness will not allow his memory to be lost, so much the more since I see revived in you the virtue of so great a captain, since one of his principal virtues was constance in the most adverse fortune. In the midst of the sea he was able to endure hunger better than we. Most versed in nautical charts he knew better than any other the art of navigation, of which it is a certain proof that he knew by his genius and his intrepidity without anyone having given him the example how to attempt the circuit of the globe which he had almost completed." [1]

Many men have had a worse epitaph : few men have deserved a better.

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Lord Stanley of Aldersley, *The First Voyage round the World by Magellan, translated from the Accounts of Pigafetta and other Contemporary Writers.* (Hakluyt Society, 1874.) This contains a translation, with short notes and an introduction, of all the relevant contemporary documents, the authorship of some of which is in dispute.

Some additional information will be found in *Early Spanish Voyages to Magellan's Strait*, edited by Sir Clements Markham (Hakluyt Society, 1911). There is also a *Life of Magellan*, by F. H. Guillemard (London, 1890). See also the article *Magellan* by Prof. Beasley, in the *Encycl. Brit.* (11th edition, vol. xvii, p. 302).

The Antiquity of Man in America—I[2]

By E. N. Fallaize, B.A.

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AMERICA has always been a centre of interest to the student of man and his culture. The highly developed civilisation of the central area has been the subject of many theories, fantastic and otherwise, while the origin of the American race—a race lauded as the noblest or vilified as the basest of mankind according to the prepossessions or prejudices of early writers—was a puzzle which for long was the subject of conjecture. In the circumstances it need hardly be said that the original stock has not failed to be derived from the ubiquitous Ten Tribes of Israel. In the early days of discovery the Indians were held to be outside the pale of humanity because they were not mentioned in Holy Writ ; while a more lenient view regarded them as the descendants of the Canaanites expelled from the Holy Land by Joshua.

In considering the origin and antiquity of man in America and the relation of this problem to the question of the evolution of the human race, there are, broadly speaking, three problems which present themselves for consideration :

1. What was the origin of the American-Indian population found by the Spanish explorers on their arrival and as it exists to-day ? Was this population aboriginal or was it immigrant ? In the latter case, when and whence did it arrive ?
2. What degree of antiquity can be assigned to the existence of man on the American continent ?
3. If a high degree of antiquity can be assigned to man in the New World, and if we accept the view which derives all races of men from a single origin, does the evidence point to an origin in the Old World, from which early man in America is an offshoot, or, *vice versa*, was the old world stock derived from America ?

Interest in these questions, upon which there had come to be almost a general agreement among a majority of anthropologists, has again been aroused by the discovery of a fossil tooth of an early human or sub-human type in the Upper Snake Creek beds of Nebraska. The tooth was forwarded to the American Museum of Natural History by its finder, Mr. Harold L. Cook, of the United States Geological Survey, and is described by Professor Henry Fairfield Osborne in *American Museum Novitates* of April 25 last. It has been pronounced by two eminent authorities on fossil teeth, Drs. W. D. Matthews and W. K. Gregory, to belong to a hitherto unknown species more nearly resembling *Pithecanthropus erectus*, the ape-man of Java, and man than the apes. *Pithecanthropus erectus* is now regarded by most competent authorities as definitely within the human family, and, up to the present, has been held to be its earliest representative. Although it was at first assigned to the Upper Pliocene, the last phase of the Tertiary period, it is now considered to belong to the Pleistocene, the first period of the Quaternary Age, immediately preceding geologically recent times. As the Upper Snake Creek beds belong to the Upper Pliocene, both the geological and the morphological evidence suggest that in this tooth we have a relic of the earliest and most primitive member of the human family yet known.

It will immediately be apparent that this discovery, should further investigation bear out the estimate of its early character, has a bearing of immense importance on the general problem of the origin and antiquity of man, as well as on the history of the human race in

[1] Stanley, p. 102.

[2] For the order of the geological ages mentioned in this article the reader is referred to the table illustrating Professor Wegener's article in DISCOVERY for May last.

America. To appreciate fully, however, the relation of this latest discovery to the views now generally current and its meaning and place in the scheme of our knowledge of the line of human development, some familiarity with the American evidence as a whole is essential.

The reader need not be invited to consider here theories of the origin of American culture—though an important feature in certain aspects of the problem—but to confine his attention to the evidence afforded by those skeletal remains to which high antiquity has been attributed. For the sake of clearness in the argument, however, it is most convenient to deal at the outset with the first of the three problems mentioned above.

It is now generally agreed, firstly, that the Indian in all the varieties in which he exists to-day on the American continent (barring the more distantly related Eskimo) exhibits certain common physical characteristics such as (1) skin-colour, (2) character, distribution, and growth of hair, (3) colour of the eye, and (4) the fact that the eye is usually set slanting upwards in the outward direction, in which he agrees to such a degree with the peoples of Eastern Asia and Polynesia as to suggest the conclusion that he derives from the same stem; secondly, that he represents an intrusion which came from Eastern Asia and spread over the continent from the north-west; and, thirdly, that this intrusion did not take place in the form of a migration, but in a series of waves after the stock had reached a stage of development superior to that of the latest Pleistocene man in Europe and had acquired certain characteristics differentiating it as a type, in effect, as clearly as those which mark the stock to-day. As regards the date of this intrusion, some would place it at the later Pleistocene at a time when Asia and America were joined by a land bridge at a latitude extending southwards to at least somewhere about what is now Alaska; other authorities would make it as late as early "recent" times, holding that it would be possible to cross from the one continent to the other by passing from one group of islands to another over water and ice without the assistance of a complete land bridge. The how and when are of less moment for the present purpose. The important point is that if it be accepted that the existing American Indian type is derivative in comparatively recent times from Asia, the investigation of the date and place in human evolution of the remains for which a high antiquity is claimed, is no longer hampered by the necessity of establishing a relation between the early and the modern types. At the same time, as will be seen later, resemblance to a modern type becomes a conclusive, and sometimes is the only, piece of evidence afforded by a discovery of human remains which gives a clue to their age.

The question of date rests upon geological and palæontological evidence. Before proceeding to examine specific cases in some detail, it may be said that the geological conditions, in the northern half of the continent at any rate, conform on general lines to the conditions prevalent in the Old World. The evidence points to an Ice Age with four periods in which there was an advance of the ice-sheet and with milder periods intervening. These correspond to the four cold periods with milder interglacial periods now very generally accepted as representing conditions during the Ice Age in Europe. In both cases the problem is to determine the relation of the evidence for man's existence to these periods of glaciation and interglaciation; but, whereas in Europe the question resolves itself into the interpretation of data which are established with a reasonable amount of certainty, in America, unfortunately, the data are either entirely lacking, or are themselves in dispute. Lack of scientific method in recording exact details of the circumstances and conditions of discovery has deprived them of much of their value as evidence. In the earlier finds precise geological data are rarely to be had, and, even where such data are forthcoming, no observation was made as to whether the stratum containing the skeletal remains was undisturbed. In other words, we have no means of determining whether the position of the human remains discovered was due to deposition at the same time as the stratum in which they were found to be lying, or was the result of a later introduction by human action (i.e. interment) or by natural forces such as a flood or "wash out."

Turning to the finds in detail, fourteen discoveries of human remains in North America have been recorded in which the circumstances appeared at first sight to warrant a claim for a high antiquity. Of these, the more important are as follows:

In 1844 a complete skeleton was found in New Orleans, Louisiana, in the course of excavations for gas-tanks at a depth of 16 feet, under the roots and stumps of no fewer than four successive growths of trees standing at different elevations. On this basis it was calculated that "the human race existed in the Delta [of the Mississippi] more than 57,000 years ago." The bones, apparently, were not fossilised, nor does the description of them suggest an essentially primitive type; but they have not been preserved.

A claim for antiquity based upon the evidence of the growth of trees was also made in the case of the skeleton from Soda Creek, Colorado, which was found in 1860 at a depth of 20 feet under gravel which was being mined for gold. There is little doubt that this was an intentional burial.

In 1847 a pelvic bone was found at the base of a high cliff near Natchez, Mississippi, at least 2 feet

below skeletons of species of mastodon and megalonyx. This association with extinct mammals was taken to indicate a remote date. Sir Charles Lyell, who personally examined the locality, was of the opinion that the human bone came from a burial at the top of the cliff, whereas the remains of the extinct mammalia had been dislodged from a lower position. The bone has been pronounced to differ in no respect from the corresponding bone of recent man. A find of human bones associated with those of the mastodon at Charleston made in the sixties is discounted by the presence of a fragment of porcelain.

Fossilised human remains have been found in more than one locality in Florida, notably at Lake Munroe in 1852 or 1853, and at and in the neighbourhood of Osprey in 1871 and succeeding years. Further investigation has shown that the type of fossilisation exhibited by these remains may take place within a comparatively short period and affords no criterion of great age.

The most important of the earlier finds, and one which attracted very considerable notice at the time, was the Calaveras Skull, found in 1866 at Bald Hill, near Altaville, Calaveras County, California, in auriferous gravel dating from the Middle Tertiary period, in a mine-shaft at a depth of about 130 feet from the surface. It is a male skull of an individual of advanced years, and is of an intermediate type between long and broad. The forehead is of medium height, but not sloping, as in most skulls of low form. The eyebrow ridges are strong, but not especially prominent. A comparison with the skull of a Digger Indian from Calaveras County led Dr. G. A. Dorsey to the conclusion that the two skulls had the same general character and might readily be pronounced to be of one and the same type. The Calaveras Skull also corresponds in all essential features with a cranium from a cave in the same county which was presented to the National Museum in 1857. The body of evidence in favour of the geological antiquity of this skull is of greater weight than in the case of any other find; but the balance of probability, taken in conjunction with its resemblance to the cave skull mentioned above, which is "recent," and the fact that the considerable number of implements, etc., found in similar circumstances conform to the normal Indian types of stone implements, must be taken as against any very remote date.

A discovery to which much importance has been attached, both on morphological and on geological grounds, was made in 1866, when a skull and lower jaw were found at a depth of 3 feet in a fissure at Rock Bluff on the Illinois River in drift material of the region consisting of clay, sand, and broken stone, the whole covered with a stratum of surface soil. It was held in 1867 that the skull was not comparable to any of the aboriginal American cranial forms, while its position pointed to an antiquity, possibly, of the glacial epoch. For the latter conclusion, however, there was very little evidence, and there can be little doubt that the deposit in which the skull was found had been washed into the rift. The morphological evidence was its apparently low type and greatly developed supraorbital (eyebrow) ridges. Dr. Hrdlička, who has made a careful examination of the skull, points out, however, that this development is not comparable to that characteristic of the Neanderthal man of Europe in the early Palæolithic Age, but belongs to the type of supraorbital ridge found in some Indian skulls from the Illinois River mounds. It cannot, therefore, be regarded as evidence for geologically early man.

Of all these finds of skeletal remains, with the possible exception of the Calaveras Skull, the most interest attaches to the crania found at Trenton, New Jersey, where the conditions in certain respects approximate more nearly to those under which vestiges of early man have been found in Europe. The district is rich in deposits of glacial gravels, and for nearly forty years the Delaware Valley has been subjected to a close scrutiny with a view to determining whether man was present there before the advent of the Indian. Although many were inclined to regard the implements found as of late-glacial or immediately post-glacial date, Professor Putnam, who carried on careful investigations for a great number of years, suspended judgment, while Dr. Hrdlička, who subjected the osteological material to a careful examination, was definitely of the opinion that, with two exceptions, the crania were to be regarded as Indian in type. The two exceptions, the Burlington Skull and the Riverview Skull, could not be referred to any known aboriginal race. Both skulls are of a peculiar and similar type, unusually low, with narrow face, though the cranium is broad. Apart from other differences, which appear in the detailed measurements, the small height would be sufficient to differentiate these skulls clearly from the Indian type. As no other skulls of this type are known to have been found in America, they have been attributed to a race earlier than the Lenape Indians of the Delaware Valley, but Dr. Hrdlička is inclined to regard them as later immigrants, possibly Dutch, and compares them to certain skulls from Bremen, of similar dimensions, which have the lowest height-length index in the world. These skulls have been regarded as belonging to a distinct ethnic type persisting along the coast of N.W. Europe and exhibiting some resemblance to the Neanderthal race.

A find to which much importance was attached is that of the Nebraska "Loess man." In 1894, during some excavations on a low eminence known as Long Hill, about 3 miles north of Florence, near the

Missouri, a skull was found at approximately 5 feet below the level of the surface. Attention was not called to this find until 1906, when Mr. Gilder of Omaha, in exploring the mound, found a number of crania and other bones situated at different levels. Of these, some were found beneath baked clay, upon which at some time a fire had been built. The greatest depth at which any human bone was found was $11\frac{1}{2}$ feet below the surface. It would appear that a lower stratum of skeletons had been placed in the mound feet inward, and earth had been piled on top and burnt hard. At a higher level, but some 5 feet distant, was an upper layer of skeletons which, with three exceptions, had been disarticulated and the bones more or less scattered. They were well preserved, but heavy and brittle. According to one view, the bones on the upper level represented a secondary burial. Below these was an undisturbed layer of loess[1] in which were found the greater number of the skulls. It has been held that these bones at the lower level represented deposition and not burial, and that they were therefore synchronous with the loess formation in which they were found. The antiquity of the remains, it was further argued, was supported by the character of the skulls, which were regarded as of the Neanderthal type, as they had thick protruding brows, low forehead, thick skull walls, and small brain capacity. It was suggested that they held an intermediate position between Neanderthal man and the mound-builder type of North America.

On the other hand, it has been pointed out that the occurrence of eight or nine bodies in such close proximity pointed to burial rather than to deposition by natural forces. Further, the custom of building a fire on earth placed over the bodies is an occasional feature in the burial mounds of this region. The difference of level at which bones were found in the lower stratum has been explained as due to the burrowing of rodents, of which traces are evident in the mound. The absence of fossilisation in the bones would be difficult to explain were the bones really of the date claimed for them. Dr. Hrdlička is of the opinion that the presence and similarity of position of knife-marks on the edges or margins of the bones—in nearly all cases the long bones and the skull—indicates a custom such as that of cleaning the bones after disinterment as a preparation for secondary burial, while he has shown that the resemblance to Neanderthal man occurs in remains from Indian mounds in the same region as that in which the Nebraska Loess man was found.

[1] Loess: a deposit of glacial age, consisting of wind-driven and sifted sand or soil, the result of denudation. It is the product of a period of cold, and in a subsequent warm period of moisture which accompanies the melting of the ice-cap is deposited as clay, brick-earth, or mud.

An adult skeleton and a portion of the jaw of a child were found at Lansing, Kansas, in 1902, in a terrace at the foot of a bluff on the banks of the Missouri, at a depth of 20 feet below the surface, the remains being separated by a distance of about 70 feet. They occurred in an undisturbed loess-like belt which presents great variety of composition and considerable irregularity of accumulation. The site was examined by many prominent geologists; but opinion as to the geological age of the deposits remained divided, some regarding them as true loess, while others judged them to be of a much more recent age, and not laid down in glacial times. Measurements of the bones of the skeleton of the adult, which belonged to an individual of about 55 years of age, were practically identical with those of the present-day Indian of the Middle and Eastern States. In default of a clear pronouncement on the geological question the verdict on this important find must, in the light of the osteological evidence, be against a high antiquity.

From this summary account of the more important of the skeletal remains which have been regarded as belonging to early man, two conclusions emerge. Firstly, that no satisfactory evidence of geological antiquity has been adduced, the geological data being absent, or failing either to support the claim to antiquity or, otherwise, to substantiate the undisturbed character of the deposit in which remains have been found. Secondly, that these early remains in themselves exhibit none of the morphological differences which would undoubtedly be found to exist between a skull of remote antiquity and that of the Indian—a race, it is agreed, of recent introduction. In the case of possible exceptions, as, for instance, the Calaveras Skull and the Missouri skulls, it has been shown that, while they differ from the normal Indian skull, they conform in each case to a variant of that type.

(*To be concluded in the November Number.*)

The Geology and Fossil Plants of West Greenland

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From the granitic headlands of Cape Farewell, on the latitude of the southern extremity of the Shetland Islands, Greenland extends slightly beyond lat. 83° N.; it is nearly 1,700 miles long, a distance equal to that from the northern limit of the Shetland Islands to the north coast of Africa, and has an average breadth of about 600 miles. On the north-west Greenland is

separated from Grant Land, Grinnell Land, and Ellesmere Land by the narrow channels connecting Baffin's Bay with the Polar Sea: so narrow are the channels that Eskimo can easily pass across. It was doubtless by this route that the ancestors of the present Greenlanders reached the country. With Europe Greenland is closely connected geologically. In the remote past, at least, there was probably a vast continent, a northern Atlantis, stretching from what are now the highlands of Norway and Scotland to the Arctic regions of America. Greenland is in a geological as also in a biological sense a connecting link between the Old and New Worlds. By far the greater part of the island, so far as it is possible to ascertain the structure of a land almost completely covered by ice, consists of coarsely crystalline rocks mainly of igneous origin and of an antiquity that is inconceivably remote. The cliffs on some parts of the coast are built up of limestones, sandstones, shales, and old pebble beaches containing the remains of animals and plants characteristic of several geological periods and clearly indicating climatic conditions within the Arctic Circle much more genial than those at the present day. Even in the extreme north, on the shore of the Polar Sea, limestone rocks have been described by the Danish geologist Koch as "veritable coral reefs" of the Palæozoic era, the fourth era in geological time.

Greenland is a mountainous plateau mainly composed of some of the oldest rocks in the world belonging to a stage in the history of the earth (the Archæan period) which is shrouded in mystery. Of the life of this period we have no certain knowledge. On the extreme northern coast, also at many places on the east and west coasts, the presence of thick series of ancient sediments and of rocks consisting of accumulated masses of the calcareous skeletons of marine animals is evidence of recurrent subsidences of the land and the submergence of its edges. The occurrence of terraces of sand and gravel at a height of from 200 to 300 feet above the present tide-level, containing marine shells of species still living in the Arctic seas, denotes an upward lift of the coast-line in comparatively recent times. A still more recent movement, but in a downward direction, is demonstrated by a comparison of a series of photographs, taken over a period of several years by a Danish geologist, which shows that the tangled mass of brown seaweed which clings to the foot of the cliffs at low water is slowly creeping upwards. The fact that iron rings for ships' cables fastened into the rocks on the west coast are exposed only at low tide is confirmatory evidence that, on the west coast at least, Greenland is sinking.

Seen from the sea the coast of Greenland forms a long line of mountains often reaching a height of from 3,000 to 4,000 feet, the darker blue of the nearer hills shading gradually up the deep and tortuous fjords into the lighter tones of those farther inland. Off many parts of the coast lie scattered groups of islands, or skerries, like huge round-backed whales, the ice-worn summits of a submerged mountain range. Over the whole of the interior is the "dead storm-lashed desert of ice," rising in the central regions to a height of 8,000 to 10,000 feet, its surface thrown into gentle undulations and the monotony occasionally broken by a stream that plunges with a roar into a

FIG. 1.—A DYKE OF BASALT FORMING A RIDGE ON A HILL OF LIGHT YELLOW SANDSTONE.

Blocks of sandstone hardened by the dyke are seen on the left-hand side of the darker basalt.

chasm of unknown depth. Fridthof Nansen, who in 1888 was the first to cross Greenland, compared the inland ice to the gently sloping surface of a shield hundreds or even many thousands of feet in thickness. From the inland ice glaciers, like mighty tentacles, are thrust outwards towards the sea, and as the ice reaches water deep enough to buoy up the moving mass portions are broken off as icebergs. One of the most prolific berg-forming glaciers on the west coast stretches across the head of the Jakobshavn Ice Fjord (lat. 69° N.). It has been calculated that the daily discharge of ice through this ice fjord amounts to 432,000,000 cubic feet. The surface of the water as seen from the hummocky coast behind Jakobshavn is a continuous mass of icebergs, some floating, some stranded, all huddled together in disorderly array, suggesting the fall of a stupendous avalanche into the waters of the fjord. At the western end of the fjord the icebergs set out to sea drifting, it may be, many

hundred miles before they melt or come to rest on the shore of Newfoundland or even farther south, breaking up like ships aground.

The fossil-bearing rocks it was our aim to investigate during the summer of 1921 are exposed along the shore and in the ravines of Disko and other islands, and especially on the Nugssuaq peninsula. Most of

FIG. 2.—A VIEW NEAR GODHAUN

Showing part of the high basaltic plateau of horizontal beds of lava and ash and, below the snow-covered talus slopes, the darker hummocks of Archæan gneiss; grasses on the sandy beach in the foreground.

them were deposited during the Cretaceous period; others are Tertiary in age.[1] Slabs of rock detached with the aid of a pickaxe from the side of a ravine where the hills are made of a succession of sheets of sediment—the sands and muds of some ancient lake or lagoon—are found to be covered with the clearly outlined impressions of large leaves like those of the Plane or Tulip tree, fronds of ferns hardly distinguishable from species (of the genus Gleichenia) living to-day in tropical and sub-tropical countries, twigs and cones of Conifers, some of which are almost identical with those of the Mammoth tree (*Sequoia gigantea*) now confined to a narrow strip of the Californian coasts, and massive stems of forest trees. None of the leaves preserved in the Greenland rocks have a greater fascination for the student of the past history of living plants than those of the genus Ginkgo. This genus is now represented by a single species, the Maidenhair tree (*Ginkgo biloba*), which is sometimes said to occur in a wild state in China, though it is probable that even in China and Japan, where it grows abundantly, it exists only as a cultivated tree associated in the Oriental mind with some religious symbolism. Some of these fossil leaves are indistinguishable from those of the sole survivor of this ancient genus at several localities within the Arctic Circle as in many other regions of both the Old and New World; and their preservation strikingly illustrates the possibilities, offered by a study of the records of the rocks, of connecting the present with the past, of following the wanderings over the world and of tracing the rise and fall in their fortunes, of still living members of the plant kingdom.[2]

These fragmentary relics, "the ghostly language of the ancient earth," suggest problems that are more easily stated than solved. Two among the problems which exercise the ingenuity of geologists and botanists may be mentioned: if, as seems certain, the climate of Greenland was warm enough to support a vegetation, including forest trees and other plants closely related to species now growing in warm temperate and sub-tropical districts in North America, southern Europe, China, and elsewhere, what were the causes for the change to the present conditions? Of the plants that exist in Greenland some occur also in different parts of Europe, others have their nearest relatives in North America. Where was the original home of the Arctic floras, and what was their fate during and subsequent to the Glacial period which reduced North America and North and Central Europe to much the same condition as that of Greenland to-day? Much has been written on the causes governing climatic changes in the past; but the question is still under discussion. Mr. Porsild, the Director of the Danish Arctic Station, has recently summarised the views of botanists on the origin of Arctic floras and on the effect of the Glacial period on the pre-glacial vegetation: he believes that the Ice Age was fatal to the vegetation and that the present plant population of the country arrived across Smith Sound on the north-west and spread over the ice-free fringe of Greenland.[3]

Thomas Hardy in *The Return of the Native* speaks of Clym Yeobright walking alone on the heath "when the past seized upon him with its shadowy hand, and held him there to listen to its tale. His imagination would then people the spot with its ancient inhabitants." Similarly the waifs and strays from the vegetation of the past enable us with a certain degree of accuracy to reclothe the hills with plants of other days and other climes. It is impossible with precision to interpret in degrees of temperature what the buried leaves and twigs indicate; but we may safely say that they belong to plants which could not have existed under conditions comparable to those endured by the present Arctic vegetation.

Many of the localities visited were on uninhabited coasts where the land rose gradually inland for a few

[1] The Cretaceous period is the first period in the Mesozoic or Secondary era. This era is the third oldest in geological time, being directly preceded by the Tertiary. See DISCOVERY, vol. iii, No. 29, p. 115.

[2] For a fuller account of Ginkgo and other survivals, see *Links with the Past in the Plant World*, by A. C. Seward. (A volume of the Cambridge Manuals of Science and Literature.)

[3] Mr. Porsild's article is in a comprehensive work on Greenland recently published in Copenhagen. (*Grønland*, 2 vols. Edited by G. C. Amdrup and others. Copenhagen, 1921.)

hundred yards, then the gradient rapidly rose up the face of a mountain. Deep ravines laid bare a succession of sedimentary strata 1,000 feet or more in thickness, over which had been piled layer after layer of lava-flows and beds of volcanic ash. The widely spread sheets of basalt (in some places as many as thirty superposed layers), which give a terraced appearance to the weathered face of the cliffs like that of the rocks of Mull and other islands off the west coast of Scotland, are proof of long-continued volcanic activity on a stupendous scale. The photograph (Fig. 2), taken near the Arctic Station on Disko Island after a recent fall of snow, shows very clearly the layers of lava and ash above the talus slopes.[1] The darker rocks in the foreground belong to the much more ancient crystalline series which forms the greater part of Greenland. Another expression of volcanic phenomena is seen in the numerous dykes which frequently cut across the beds of sandstone and shale. A dyke consists of some igneous rock, often basalt, that has been forced from below through cracks and fissures in the overlying strata. The softer rocks fall an easier prey to the action of the weather than the harder and more compact dykes, which are left as great ribs or dark-brown buttresses projecting on a light-yellow background of less resistant material. Part of a dyke of dark-brown basalt is seen at close quarters in Fig. 1; it resembles a partially ruined wall on a wind-worn denuded field of sand, the result of disintegration of beds of soft sandstone. Here and there adhering to the sides of the dyke are blocks of sandstone which were hardened and rendered more resistant to denuding agents by contact with the molten rock which welled up against their fissured sides.

From the beds of shale exposed in the cliffs on the south coast of Upernivik Island (lat. 71° N.) above the beach, littered with boulders, several impressions of fossil plants were collected, including pieces of the large fronds of a Cycad, a plant related to the so-called Sago Palms, the majority of which flourish in the Tropics. An almost vertical dyke thrust through the old sediments forms a prominent feature on the left (Fig. 3). The two massive mountains in the distance are portions of the highlands, bordering the western edge of the Umanak fjord, composed of some of the oldest rocks in Greenland. One of the most striking mountains in Greenland, recalling in shape the Matterhorn, rises almost sheer from the sea as a wall of igneous rock nearly 4,000 feet in height on the small island of Umanak off the north coast of the Nugssuaq peninsula. The salmon-pink mass is cut across halfway up the precipice by a thin black band bent on itself like an S lying on its side, an eloquent witness to the intensity of the forces which folded and crumpled the rocks of which the Umanak mountain remains as a detached and magnificent bastion that in the course of ages has been fashioned into its present form. Near the base of the cliff is the settlement of Umanak with the native huts and timber houses built on the small level patches among the rounded hummocky rocks which form a massive plinth to this pyramid that dominates the island.

One of the best localities in West Greenland for fossil plants is Atanikerdluk, an uninhabited part of the south coast of the Nugssuaq peninsula. The main ravine is not only of special interest geologically; it also affords a most remarkable display of dykes, and illustrates on a grand scale the relation between scenery and rock structure. A stream flows among jumbled heaps of boulders at the bottom of a steeply inclined valley; the valley slopes consist of natural embankments of loose light-yellow sand mixed with milk-white rounded pebbles of quartz detritus formed by the erosion of the sandstones, which are here the dominant rocks. In places the talus slopes are replaced by exposures of the rocks themselves, thick beds of sandstone with no division into layers, thinner well-stratified beds, bands of shale, and an occasional seam of coal. These sedimentary strata, having a total thickness of many hundred feet, exhibit here and there on an exposed plane of bedding a series of ripple-marks and afford other evidence of their origin as sheets of sand and mud in shallow water and among drifting currents. Many of the sandstones are made

Fig. 3.—THE BEACH, UPERNIVIK ISLAND

On the left an obliquely vertical dyke of basalt (behind the large boulder in the foreground) cuts across the sedimentary rocks; the mountains on the right are composed of older (Archæan) igneous rocks.

up of thin layers, often rendered more conspicuous by the presence of iron-stained bands, which exhibit the well-known arrangement spoken of as current-

[1] I.e. the sloping mass of fragmentary stones often found at the foot of cliffs or rocky declivities.

bedding—a series of layers sloping at a certain angle is cut off by another set sloping in a different direction. This frequent variation in the lie of the thin beds is evidence of the deposition of sandy sediment in water with eddying and shifting currents. Dark-brown dykes cut across the sands, and sometimes intersecting dykes project like pieces of a huge network. An even more impressive example of intrusions of igneous rock is afforded by vertical walls of basalt which stretch across the valley. These magnificent dykes do not form continuous curtain walls from one side of the valley to the other, but the rocks are twice or thrice stepped on each side: the light-brown wall of basalt towers against the sky at least 100 feet above the upper level of the slope of the ravine. Its jagged and weathered ledge projects horizontally for some distance towards the middle of the valley and is then cut vertically down into a deep step, and this is repeated two or three times. At the foot of the valley the dyke crosses the stream as a resistant barrier where the water falls in a cascade. The light-yellow colour of the sandstones and the darker tones of the basalts are relieved by clumps of bright yellow Dandelions and Arnicas, purple Willowherbs, and clusters of the tall russet-brown Oxyria, a plant allied to the common Dock.

A Peasant Poetess of Normandy

By George Frederic Lees

One might search for a long time in the annals of literature before finding a parallel to the case of the Normandy poetess, Rose Harel, with whose shade and amidst whose memories, in orchards laden with apple-blossom, I spent a happy vacation some months ago. For this remarkable woman was of peasant origin, at any rate on her mother's side, and yet she showed, in one springing from the soil and without any early education, a delicacy of feeling and faculty of poetic expression which are remarkable.

Who that *père inconnu* inscribed with the entry of her birth (in 1828) in the registers of Bellon, a humble little village in the Department of the Orne, was will never be known, but it is not unreasonable to suppose that he was a man of somewhat higher position and education than her mother. Rose was neglected and uncared for from the very beginning of her life, but was by no means an unhappy child, since in after-years she always spoke with affection, both in her poems and in private conversations, of the little cottage covered with Bengal roses, around which she spent her days in perfect freedom. Chiefly on account of her mother's indifference to her welfare, but also because of poverty, schooling in France in those days being exceedingly dear, she received not even the rudiments of education.

It was not until she had reached the age of thirteen that she was taught her letters. At that time she was working a hand-loom in a noisome cellar at Vimoutiers, weaving being thought more suited to her delicate constitution than the rough work of the fields, to which children of her class were generally put. Two or three friends in the same humble station of life as herself took pity on her and assisted her to the best of their ability. Another friend a little later gave her lessons in writing and spelling in the evenings, when hand and eye were weary with the day's work. Rose showed invincible courage in learning, and her active brain enabled her quickly to make up for lost time. Once having learnt how to read, she read everything that came within her reach with the utmost avidity. There was one book in particular (almost the first, if not actually the first, notable work which fell into her hands) which had a special charm for her, and exercised a powerful influence on her rapidly growing mind—a much-dilapidated copy of the *Aventures de Télémaque, fils d'Ulysée*, which one day she found in the attic of the house where she was employed. Weary with fatigue, and overcome with sadness at her hard lot, the sensitive girl had fled there from her damp cellar, little expecting to meet with such a friend. This graceful prose poem, produced by Fénélon in 1699, was for quite a century and a half the most read and appreciated book in France. Lamartine, whose melancholy nature had much in common with that of Rose Harel, bears witness in the preface to his *Premières Méditations* (1820) to the benefit received when a child from reading Tasso's *Jerusalem Delivered* and Fénélon's *Télémaque*, which he found on a dusty shelf in the drawing-room of his father's country house. Its gods and goddesses, nymphs and satyrs, shepherds playing on flutes under the shade of young elms or by the side of clear fountains, were people of a new world to Rose Harel—a new and yet, at the same time, an old, familiar world which she often felt she had known since earliest childhood. Passages on nature touched her strangely. There were, indeed, many things described in *Télémaque* which she had seen with her own eyes in her native Normandy: lands covered with a golden harvest of fruit under the heavy weight of which labourers bowed their shoulders, smiling valleys and fields, shady groves gemmed with flowers and ringing with the song of birds, and dark, mysterious forests full of strange sounds and fragrant odours. And it was largely in

making this comparison between Fénélon's somewhat artificial description of the ancient classical world and the very real pictures of nature with which she was surrounded that her mind developed in its particular direction.

Almost simultaneously with the writing of her first poems she determined to give up weaving, owing to the detrimental effect which work under such terrible conditions as those already mentioned was having on her health, and become a general servant. The history of letters contains many pathetic stories, but I think there is hardly one sadder than that which opened at this period of Rose Harel's life. Her entering into service was the signal for a multitude of misfortunes and, worse still, persecutions, which only ended with her death. During more than thirty years she passed from house to house in Vimoutiers, Pont l'Evêque, and Lisieux, hardly ever treated with consideration, and frequently ill-treated and ill-fed. Norman housewives could not understand this woman with high, intellectual forehead and most intelligent eyes, who showed so keen a desire for learning and who wrote poetry in her leisure hours ; they looked upon her as a vain creature, apeing the manners of women of education, and they even declared she was a *folle*. How deeply she felt this attitude may be realised from the poem, written when she was thirty, beginning "J'ai vécu longtemps pauvre, mais sans orgueil" (Long have I lived in poverty, but without pride).

Losing place after place, Rose Harel at last endeavoured, as far as lay in her power, to hide the talent which a number of friends belonging to the more intellectual section of the inhabitants of Pont l'Evêque and Lisieux had helped to foster. But in repressing her instinctive desire to put her impressions on paper she suffered much mentally. Moreover, whilst working in the cellar at Vimoutiers she had contracted tuberculosis, and her bodily health began to show signs of decline. After the appearance of her first volume of poems, which was published in 1864 by private subscription, principally through the efforts of one of her most enthusiastic admirers, M. Adolphe Bordès, she was no longer able to obtain a good position as a servant. She sank lower and lower, until, mentally cast down and undermined by disease, she was driven to accept a situation with a cheese-merchant on the Boulevard de Pont l'Evêque, at Lisieux, who employed her in scraping cheeses and in doing the rough work about the house. It was there—in a cold, pestilential, windowless cellar—that a literary lady of Lisieux, Mme. Marie de Besneray, who had been struck by the beauty of her poems, found her one winter's day, and rescuing her from bondage, provided for all her needs for the few remaining years of her life.

On July 5, 1885, the poetess died in the arms of the excellent woman who had befriended her. Not long before, the curé of the parish of Lisieux had been summoned to administer the last sacraments, but Rose declined to see him. "Ce monsieur le curé-là," she said to Mme. de Besneray, "is too grand a gentleman for me. . . . I do not want this fine cathedral God whom he brings to me. . . . If you wish to bring anyone to see me, find a good, very simple God, a good God of the countryside." A *bon Dieu de campagne* was found in the curé of Beuvillers, who persuaded her to observe the rules of the Church, but "on condition," she said, "that there are plenty of flowers." Her thoughts to the last were centred on the pageantry of nature.

Rose Harel's two volumes—*L'Alouette aux blés*, published in 1864, and *Fleurs d'automne*, published in 1885 under the auspices of Mme. de Besneray—contain abundant evidence that the things of nature moved her deeply. Her poetry, it is true, is unequal, which is not in the least surprising, but it is sweet and musical, and moreover her descriptions of the country are characterised by the strength and simplicity of Nature herself.

L'Alouette aux blés—"this book into which I have put all my soul," as she confesses in an opening poem—and *Fleurs d'automne* are both largely autobiographical. She is constantly telling the reader of her ideals and life as a child, or describing the old cottage at Bellon and its surroundings. Wandering about in the woods and fields she relates how enraptured she used to be—"sans savoir pourquoi ni comment"—by Mother Earth. In these reminiscences—pictures of shady forests, winding footpaths buried in trees, solitary places shaded by oaks and elms, waving cornfields and blossom-laden orchards—she is nearly always light-hearted and cheerful. There are times, however, when her note is entirely melancholy. A single flower is sometimes enough to make her ask herself, in her captivity amongst townspeople, if the country is really still rich with golden corn ; if the redbreast still sings there in the evening ; if chaffinches still make their nests in the moss-grown apple-trees of Normandy orchards.

> S'il me plaît d'invoquer pendant mes rêveries
> Mes premiers jours passés, mes songes de vingt ans,
> Je dis à mon esprit : "Retournez dans les champs,
> Dans les grands bois touffus, dans les vertes prairies,
> Où, jeune, j'aimais tant à m'égarer le soir
> Quand mon cœur débordait et de sève et d'espoir."
>
> Lorsque j'ai ressaisi seulement pour une heure
> Ces rêves envolés, ces souvenirs des champs,
> De mon cœur réchauffé montent alors des chants,
> Chants où l'espoir sourit, chants où le regret pleure . . .
> Espoir, bonheur, amour, fantômes du passé,
> Comme vous fuyez vite à mon souffle glacé !

[If it pleases me to invoke during my reveries
The days of youth, my dreams when I was twenty,
I say to my spirit: "Return to the fields,
To the big dense woods, to the green prairies,
Where, as a child, I loved so much to lose my way
When my heart was overflowing with joy and hope."

When I have captured again if only for an hour
Those dreams on the wing, those memories of the fields,
There rise then from my comforted heart songs
Full of smiling hope, songs full of sorrowful regret . . .
Hope, happiness, love, phantoms of the past,
How quickly you depart before my icy breath !]

Like Millet, whose rustic scenes, by the by, are sometimes brought to mind by Rose Harel's lines, this poetess was a profound believer in the voices of nature. There are many references in her poems to the mysterious voices which she heard when a child among the trees, and in brooks rippling over pebbles and between mossy banks. That they did not always bring happiness to the hearer she was ready to admit, and in one poem, entitled "Conseil," she cries :

N'écoute pas la voix qui chante,
Enfant, à la rive des bois,
Voix mélancholique et touchante
Qui prend l'être entier à la fois.

[Listen not, Child, to the Voice
Which sings at the edge of the wood,
The melancholy and touching voice
Which at once absorbs one's whole being.]

Not that the voice spoke falsely, but because the contrast between the poet's vision and the world to which she would have to return was so disheartening. In spite, however, of the disillusionment which Rose Harel so often experienced, she would not for the world have relinquished her power ; she had too true a poet's heart to lose faith because of momentary suffering :

Ce que me disent le brin d'herbe
" Que Dieu ne créa point en vain "
Et le chêne à l'aspect superbe
Qui croît sur le bord du ravin,
Nul ne le sait, nul ne s'en doute,
Nul ne comprend ce que j'écoute
De leur idiome divin.

Jeune, j'avais le privilège
De comprendre déjà ces voix ;
Oh ! combien de fois m'attardai-je
A les écouter dans les bois !
Elles me parlaient d'espérances,
Ces menteuses voix du silence ! . . .
Et j'y croyais, comme j'y crois.

Depuis j'ai versé bien des larmes,
J'ai bien souffert, j'ai bien gémi,
Et j'ai toujours senti leurs charmes,
A leur accent, toujours frémi.
Qui dans son âme, un jour blessée,
Voit la poésie effacée,
N'était poëte qu'à demi.

[That which the blade of grass telleth me—
The grass "which God created not in vain"—
And the oak of proud bearing
Which grows on the ravine's edge,
No one knoweth, no one suspecteth,
No one can guess what I understand
Of their divine language.

Even when young, it was my privilege
To understand those voices.
Oh ! how many times I tarried
To listen to them in the woods !
They spoke to me of hope,
Those deceitful voices of silence ! . . .
And I believed in them—as still I do.

Since, many tears have I shed,
Much have I suffered and many my groans ;
But I have ever felt their charm
And at their accent ever trembled.
He who, one day, with wounded soul,
Saw poesy effaced
Was but half a poet.]

Fleurs d'automne, which marked a considerable advance on her preceding volume, contains many poems in praise of country life. Some of these are very popular in certain parts of Normandy, country people and their children in the neighbourhood of Lisieux and Pont l'Evêque, for example, knowing them by heart. They are, indeed, just the kind of poems to appeal to the imagination of peasants : simple, naïve descriptions of their cottage interiors, with the family sitting around the fireside on winter nights, telling stories, and of the manifold joys of their healthy village life.

Wanderers into little-known by-paths of French literature would do well not to overlook the life and work of this Normandy poetess. An uneducated peasant woman who could attain to such wonderful facility in literary expression in the face of so many difficulties, who at the age of thirty studied Greek and Roman history, the literature of her own country, and philosophy, who astonished everybody by the scholarly knowledge with which she could speak on these subjects, and who, at a time when hardly anyone in France spoke of the betterment of woman's position, was a convinced *feministe*, was certainly no ordinary mortal.

BIBLIOGRAPHY

L'Alouette aux blés. (Lisieux, 1864.) Published by private subscription under the auspices of M. Adolphe Bordês.
Fleurs d'automne. (Lisieux, 1885.) Edited by Mme. de Besneray.

New air schemes shortly to be operated include a London–Brussels–Cologne service by the Instone Air Line, a London–Amsterdam–Bremen–Berlin service by Daimler Hire, Ltd., and the Southampton–Cherbourg and Channel Islands service mentioned in last month's Discovery.

Reviews of Books

THE DEVELOPMENT AND APPLICATION OF PSYCHO-ANALYSIS

Introductory Lectures on Psycho-analysis. By Prof. SIGMUND FREUD, M.D., LL.D. (George Allen & Unwin, Ltd., 18*s.*)

Fundamental Conceptions of Psycho-analysis. By A. A. BRILL, M.D. (George Allen & Unwin, Ltd., 12*s.* 6*d.*)

The Psycho-Analytic Study of the Family. By J. C. FLUGEL, B.A. (The International Psycho-analytic Press and George Allen & Unwin, Ltd., 10*s.* 6*d.*)

The publication of Professor Freud's recent lectures on Psycho-analysis is an event of considerable importance to those who are interested in modern psychology, for it is now more than twenty years since the theories were first propounded, and during this time, as fresh material was brought under survey, they have undergone almost continuous modification and development, though it is chiefly only in their earlier—and cruder—form that they are known to the general public. The theories were received for the most part with an indignant opposition which was unhesitatingly attributed by those who upheld them to prejudice due to sexual repression or to wounded *amour propre*. This may well have been true, at least in part, but some of the opposition may also be ascribed to the singular infelicity with which the theories were presented, and to the failure of many of those who undertook to expound the theories to understand them or to follow their development.

As a typical modification we may take the change of attitude concerning the effect of shocks, especially of a sexual character, experienced during early childhood. These shocks were at first held to be important factors in causing nervous trouble in later life, though they had often been forgotten, and were only recalled to memory during the analysis of the nervous symptoms. It was found, however, that many of the more lurid experiences of childhood related during psycho-analysis were—as often as not—imaginary, that is phantasies "projected backwards" from a later period of life. A deeper and more continuously operative cause had therefore to be sought as a determining factor of the trouble.

As another example we may take an aphorism, which gained a wide currency, from Freud's *Studies in Hysteria* (1895)—the generalisation that "in a normal sexual life no neurosis is possible." In his recent lectures he says (p. 322): "In a very short time my efforts had brought me to the conclusion that no neurosis—actual neurosis I meant—is present when sexual life is normal." This is a very important modification, for the "actual neuroses" comprise but two types of nervous disorder, and two that are but rarely met with; yet Dr. Brill on p. 29 of his *Fundamental Conceptions of Psycho-analysis* says, "Freud's dictum that no neurosis is possible in a normal sexual life holds true even in the psychics," thus perpetuating and extending an error that has long been recognised as such, and has been corrected by Freud himself.

It is not very surprising that the Freudian school has been described as "deriving everything from sex," but the actual position is given by Professor Freud when he says: "Psycho-analysis has never forgotten that non-sexual instincts also exist; it has been built upon the sharp distinction between sexual instincts and Ego-instincts; and in the face of all opposition it has insisted, *not* that they arise from sexuality, but that the neuroses owe their origin to a *conflict* between Ego and sexuality."

In the later developments of Psycho-analysis, the focus of interest seems to be shifting from the study of the libido ("the instinctive forces of the sexual life") to the study of the "Ego-instincts," that is, to the instincts of self-preservation and those impulses by which the individual endeavours to adapt himself to the demands of reality.

But Professor Freud deals only briefly with these later developments of Psycho-analysis, for their field of investigation lies for the most part in the difficult region of the more severe mental disorders, and the lectures are essentially an introduction. He begins with a series of lectures on the psychopathology of every-day life, and devotes a second course of lectures to the psychology of dreams, leading on to the third and last course, which deals with the general theory of the neuroses.

Professor Freud seems a little angry sometimes with those who have opposed his doctrines, and there is rather more than a hint of irony in his elaboration of the difficulties that his hearers will find in accepting his theories. Early in the book there is an echo of the pessimism, that to some of us seems to be faintly heard in all his writings, when he says of sleep: "Our relationship with the world which we entered so unwillingly seems to be endurable only with intermissions; hence we withdraw again periodically into that condition prior to our entrance into the world; that is to say into intra-uterine existence"—a discouraging view of life that would seem rather to be the expression of the writer's feelings, than a necessary corollary to his theories.

Dr. Brill approaches the subject in a very different spirit. The material of his book was taken from a course of lectures, and must have retained much of the form in which it was delivered, for it is written in a hearty, conversational style that recalls the confident experienced physician addressing an audience of students.

The greater part of the book is taken up by a vivid description of the practical application of psycho-analytical methods with many illuminating examples, and so much the reader will learn in the easiest possible way. But the fundamental conceptions of psycho-analysis are very lightly dealt with, and it is doubtful if the reader will carry away a very clear idea of them.

Dr. Brill is a psychiatrist of long experience, and many of his examples are drawn from cases of insanity, so that, although he touches upon other aspects, it is chiefly in its relationship to morbid conditions that the subject is presented. But, though analytical psychology grew out of the study of nervous disorders, it has far wider applications, as, for example, in the fields of anthropology, education, and sociology, and it may even be found that its greatest

value will lie in these directions, less, that is, in treating the neurotic conditions than in preventing them by giving a deeper understanding of the individual and social difficulties from which they arise.

Mr. Flugel's book is therefore, in its way, no less important than Professor Freud's, for this reason: the problems with which it deals, the reaction of the family relationships upon the character of the individual and his attitude towards society, are as urgently in need of study as they have hitherto proved baffling. The author professes to do little more than to apply the methods of psycho-analysis to these problems and to summarise the work of other investigators; yet he has added, as his own conclusions, some very valuable indications of the lines along which the difficulties arising out of the family relationships may be guarded against and minimised. These conclusions he has modestly relegated to the last chapters in which, observing a distinction only too rarely to be met with among psychological writers, he has confined those theories that are not yet clearly supported by observation and induction. It is possible that many readers may find the views expressed difficult to accept, and on one point, that of the origin of birth-phantasies, the author seems to take up an extreme position; but the whole book is closely reasoned (though sometimes the evidence seems a little frail to support the theories built upon it), and clearly, even brilliantly written. Many subjects come within the scope of the title—folk-lore, history, religion, literature—and a wide circle of readers should find the book valuable and interesting.

F. A. Hampton.

RECENT DISCOVERIES IN LATER GREEK LITERATURE

New Chapters in the History of Greek Literature, Recent Discoveries in Greek Poetry and Prose of the Fourth and Following Centuries B.C. Edited by J. U. Powell and E. A. Barber. (The Clarendon Press, Oxford, 10s. 6d.)

In this book, which appears a round thirty years after Professor Percy Gardner's *New Chapters in Greek History*, Oxford pauses to take stock of the results achieved in a branch of research in which she has won high distinction in the interval. With the papyrological discoveries of the past thirty years, the names of Grenfell and Hunt, of Queen's College, will always be prominently associated; we have abundant evidence in the present book that other colleges are well equipped to take their share in one section of the heavy task still awaiting completion, the interpretation and criticisms of the new "literary documents." The book naturally confines itself to the "literary" papyri and inscriptions; we must not forget that these represent, in bulk, but a small part of the new evidence which the papyri alone have placed in the hands of the student of ancient civilisation.

For the classical student Greek Literature used to mean the Literature of Athens, with Homer for preface, and Theocritus for epilogue. He had heard of other Alexandrians, but, unless he was interested in Roman literary origins, he seldom read them. The period between the bloom of Athens and the last century of the Roman Republic, a period of great interest to the historian, was for the student of Literature practically a blank. Menander, Herondas, Ephorus, and others were little more than names. The student could see that Menander had a profound influence on Roman Comedy, but he had not the least idea why.

And lo, these names are names no longer, but living men. Authors in every literary genre, moralists, lyric poets, historians, dramatists, orators, walk on to the stage of Literature and make their bow. The parts they have to declaim are generally brief; but it is something to learn Menander's idea of the construction of a plot, to get a real hold on the shadowy Philodemus, to know at last what was wrong with the music of Timotheus. We are already so familiar with the *Constitution of Athens* and with Herondas that we are apt to forget that both are discoveries of the last thirty years.

A brief review like the present must select, and we make no apology for singling out for special notice—as the editors require no apology for including—a document which falls outside the limit of period fixed in the subtitle of the book. The Epicurean philosophers, as the new Philodemus comes to remind us, forestalled the Christian doctrine of verbal inspiration with all its implications, and condemned themselves to interminable discussions as to "what Epicurus or Metrodorus, or any of the other masters, really said or meant." It takes our breath away to learn how seriously Philosophy took herself in those days. The Epicurean fraternities in different cities were in continual communication with each other, controversy over the meaning of the *ipse dixit* went merrily forward, and you had a Rhodian and an Athenian interpretation just as in later days you find a Constantinopolitan confronted by an Alexandrian exegesis. We hear complaints that the "disputants do not even take the trouble to check their references. They say, 'Epicurus wrote thus,' but they cannot say where"—reminding us of a delicious remark in a letter of Synesius, the soldier-bishop of Cyrene, that "he couldn't remember the exact words, but could assure his correspondent that this statement is attributed to God in the Bible." Late in the second century of our era an Epicurean of Oenoanda in Lycia, called Diogenes, built a *stoa* and engraved on it an inscription on the scale of the *Monumentum Ancyranum*, in which the whole gospel of Epicurus was placed before the eyes of citizens and strangers, that no man might perish for lack of the "medicine of salvation."

This is the true missionary spirit, and the inscription, of which large fragments remain, reveals a most interesting character, who is somewhat shaky in his history of philosophy, but conveys his earnest message in excellent Greek. We recall that at this very period the Pauline Churches to the north of Lycia were actively engaged in missionary work, and that a Roman road led from Laodicea to Oenoanda, and we find ourselves wondering whether Diogenes and his fellow Epicureans did more to help or to hinder the efforts of the Christian missionaries. In Lycia the history of Christianity in the first three centuries is a total blank; at the end of the third century

the province emerges, strongly Christianised, into the history of the Church. The inscription of Diogenes gives us an interesting glimpse of the ethical ideals of a section of Lycian society a century earlier. If its contribution to our knowledge of Epicurean theory is slight, it forms a notable landmark in the religious struggle which went on in the eastern provinces during the first three centuries, and has left many traces on the inscriptions of Asia Minor.

The book is the work of eleven writers. The manner in which they have executed their task under somewhat cramping conditions of space compels admiration. We have only two complaints to make. We should have liked a section on Bacchylides ; and we feel aggrieved not to be told the name of the writer of the discerning essay on Callimachus.

W. M. Calder.

The New Decameron. The Third Volume. (Oxford, Basil Blackwell, *7s. 6d.*)

Is the short story coming into its own ? There are evident signs, from the number of books of short stories now being published, that it is. One of the most interesting phenomena in this connection is the anthology of short stories by various writers. Several of them have already taken the field, but *The New Decameron*, now in its third volume, may be considered one of the pioneers, and it has certain definite characteristics of its own.

The title is not altogether fortunate, for the volume, being the work of several hands, does not compare happily with the easy, un-self-conscious tale-telling of Boccaccio. The reader cannot rid himself of the feeling that the book is machine-made, and the picture of the frantic though clever editor, attempting to graft the very diverse subjects and styles of his authors onto the main theme of the experiences of Mr. Turpin's personally-conducted touring party in France, persists in coming before his eyes.

Many well-known authors have contributed to the volume—amongst them Compton Mackenzie, D. H. Lawrence, Michael Sadleir. To our mind the two most striking stories are "Chelsea Justice" by V. Sackville West and "The Sceptical Poltergeist" by J. D. Beresford, which come at the end of the book. The first narrates the revenge which a man took on a great friend, who, he believed, had seduced his wife, by shutting him up in a buoy far out to sea off the Cornwall coast, and the second the conversation of a psychical researcher with "what the Spiritualists and Theosophists, and so on, call an 'Elemental.'" For irony and humour backed by a suggestive thoughtfulness, this last tale would be hard to beat amongst those recently devoted to the subject.

E. L.

PROBABILITY

A Treatise on Probability. By John Maynard Keynes. (Macmillan & Co., Ltd., *18s.*)

The subject of Probability has a much greater importance than it once had, and the appearance of a really comprehensive treatise on the subject is to be welcomed, especially when it bears the marks of careful and impartial, yet original, treatment shown by this volume. The day when probability was regarded as a subject only for theorists and philosophers has gone, and now, whether we are aware of it or not, a great deal of scientific work is implicitly based upon the subject. Thus, when an experiment is repeated and the arithmetic mean of the result is taken, it is implicitly assumed that such an average is the "probable" or "best" value. More often than not such a procedure is justified, but one of the functions of the theory of probability is to examine the logical basis of such methods. Given a certain set of postulates, it is possible to construct a number of theorems in probability, and it is necessary that the fundamental ideas and theorems of the subject should be carefully scrutinised on the grounds respectively of reasonableness and logical consistency. This the author has done, and his exposition of the subject is clear and convincing ; he illustrates his argument in a very interesting way, not the least interesting illustrations being taken from arguments in legal proceedings, where a judge and jury often have to determine rough measures of probability. The author gives a human touch to the subject which is very refreshing.

While most people have a fairly clear notion as to what is probable, the translation of a qualitative notion into a quantitative one is not at all simple. Indeed, the author denies that a numerical estimate of probability is always possible, and therefore he avoids an explicit definition of probability, though he has also other grounds for avoiding such a definition. Herein he differs from the procedure of previous writers who early introduced numerical methods. On the philosophical side he may be correct, but there is a need felt for some well-attested method whereby quantitative results can be given and approximate measures of probability be obtained. One of the most common methods used is based upon the frequency theory of probability, which, indeed, is the foundation of most statistical work. Mr. Keynes' discussion of this theory and of the foundations of statistical inference is a valuable portion of the book, even though one's bliss may be shown to be too highly correlated with ignorance. One function of the theory of statistics is to provide methods by which the chief characteristics of phenomena can be described, while a second is to enunciate laws or generalisations. Thus we may say that the arithmetic mean of a set of observed values of x is X, and that the standard deviation is s ; these are precisely defined and simply summarise the chief characteristics of the data. But when we infer that X is the "probable" value of x, and that s is a measure of probability of deviation from X, we imply a set of postulates and theorems concerning probability. As the main difficulties of the subject arise in the interpretation of statistical results, it is vital that there should be a thorough understanding of the conditions under which inductions can be made ; otherwise "statistics can prove anything." The author is careful to enforce the contrast between statistical description and statistical induction, and he deals almost entirely with the latter, whereas nearly all statistical treatises are mainly concerned with the former. For this reason the book is a valuable supplement to those treatises, especially as the author warns us

that the application of common sense is not a universal safeguard. The student of statistics will be well advised to read what the author has to say about the subject of statistical inference, and the book can be recommended to all students of science.

The author gives a copious bibliography, and he also includes a short account of European developments which may be new to many. A. T. DOODSON.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

The Phylogeny of Man from a New Angle. By CHARLES HILL-TOUT, F.R.S.C., F.R.A.I., etc. (Ottawa: Printed for the Royal Society of Canada.)

Tendencies in Renaissance Literary Theory. By BASIL WILLEY, B.A. (Cambridge: Bowes & Bowes, 2*s.* 6*d.*)

The Czechoslovak Republic. By JAROSLAV CÍSAŘ and F. POKORNÝ. (T. Fisher-Unwin, 9*s.*)

SCIENCE

Das feinbauliche Wesen der Materia nach dem Vorbilde der Kristalle. 3rd Edition. By Prof. Dr. FRIEDRICH RINNE. (Berlin: Gebrüder Borntraeger, 10*s.* 6*d.*)

An admirable account in German of recent work on crystal structure for specialists.

Recent Progress in Rubber Chemistry and Technology. By PHILIP SCHIDROWITZ, Ph.D., F.C.S. (Benn Brothers, Ltd., 3*s.* 6*d.*)

A résumé of recent work for specialists on the chemistry of rubber, the processes of vulcanising, etc.

Early Science in Oxford. Part II—Mathematics. By R. T. GUNTHER, Magdalen College, Oxford. (Humphrey Milford, 10*s.* 6*d.*)

The first volume of this series has been noticed in an earlier issue, and this volume will appeal to those who were then interested. It gives an account of the mathematicians, instrument-makers and their mathematical instruments, connected with the University of Oxford from early times to the beginning of the nineteenth century. It is a book of great importance to those who care for these things. The compiler is qualified both on the historical and the scientific side, and is, in addition, an enthusiast.

Evolution of the Essex Rivers and of the Lower Thames. By Prof. J. W. GREGORY, D.Sc., F.R.S. (Colchester: Benham & Co., Ltd., 2*s.* 6*d.*)

A monograph, written by one of the clearest exponents of geological subjects in our country, that should be specially interesting to East Anglians.

Radio Receiving for Beginners. By RHEY T. SNODGRASS and VICTOR F. CAMP, A.I.R.E. (Macmillan & Co., Ltd., 3*s.* 6*d.*)

An American book for wireless enthusiasts, clearly written, with good diagrams and containing much needful information.

Correspondence

THE PROBLEM OF PERSONALITY

To the Editor of DISCOVERY

SIR,

There is no doubt that the problem of personality is of great importance; in fact, it may be said that it is *the* problem from which all others derive their importance. I believe a great deal of light could be thrown on the subject if trained scientists in all branches were to devote to it even a fraction of the energy which they expend on their special pursuits. Most scientific specialists, unless I am greatly mistaken, either ignore the subject (except in their personal lives, where it is inevitable) or regard it as an abstract inquiry which is the business of specialists in philosophy and psychology.

Before any advance can be made in this direction, some provisional *meaning* should be given to the word "personality." We cannot expect to define it precisely, for that would amount to directly solving the problem.

The first point to be settled is whether the person is to be identified with the conscious Self, the centre of values from which all "things" derive their values, including the bodily organism. If this be so, we cannot possibly agree with Mr. J. S. Huxley's theory that personality is merely one of the various properties of the organism as a whole. This would be a return to the old fiction that the brain secretes feelings and thoughts just in the same sense as the kidneys secrete urine. I feel sure that Mr. Huxley did not mean this, but the ambiguity of the term "personality" leaves it open to question.

In the history of philosophy a kind of compromise has been attempted for several thousands of years. The "person," or its equivalent in other languages, has been identified with the union of the Self and a physical organism.

If this view of personality be accepted, it might form a good groundwork for scientific inquiry. But no good can come of it unless it is recognised all through that the Self is essentially distinct from the physical body The body is the *instrument* of the Self, even if it be a bad instrument. The relation is absolutely irreversible. It is meaningless to speak of the Self being the instrument of the body, since the body of itself has no values and seeks no instruments. Heredity and environment and sex are alike instruments of the Self.

Yours, etc.,
R. A. P. ROGERS.

TRINITY COLLEGE, DUBLIN.
June 28, 1922.

[The above letter is printed in accordance with our policy of allowing expression to all points of view on a question. But we doubt if any successful scientific inquiry into the problem could be carried through on the basic argument that "the Self is essentially distinct from the physical body," as it would start from an assumption of which there is, so far as strictly scientific method can guide us, no proof forthcoming.—ED.]

THE PREVENTION OF WAR: A SUGGESTION

To the Editor of DISCOVERY

SIR,

I quite expected some correspondence in the August issue regarding the question of "War" raised in your "Notes" for July. As this does not appear to have materialised, I venture the following remarks. Let us assume that war is not a biological necessity, that is, not necessary for the good of the race; that the future of the race is unaffected one way or the other by war. War, however, does harm the majority of its contemporaries and their immediate descendants, and is, therefore, a crime. Let us, therefore, perhaps through the League of Nations, declare boldly that war is a crime, and that those who declare war are criminals; let us enact in every country an unbreakable law that on the declaration of war all the members of the Cabinet (or its equivalent) be shot within twenty-four hours as criminals. Of course, some wars may be righteous wars, and in such cases, without a doubt, the statesmen concerned would patriotically give up their lives for their country by declaring war, as the soldier is expected to give up his by fighting a war for he knows not what.

The sudden dislocation of government in the two countries party to the dispute, which had occasioned the declaration of war, would, of course, give an opportunity for a further examination of the grievance by a fresh set of men, with the certain result of a peaceful settlement, the only deaths from the war being a few fiery old politicians who must have been tired of life anyway.

Yours, etc.,
PERCY J. STIRRUP.

LANGDALE,
CHURCH LANE, OXHEY,
NR. WOLVERHAMPTON.
July 28, 1922.

[The freshness of this letter would be quite spoilt by any editorial comment. . . .—ED.]

THE INVENTION OF THE PILOT CABLE

In DISCOVERY for June we printed a letter from Dr. Cargill Knott, the secretary of the Royal Society of Edinburgh, pointing out that M. William Loth's discovery of the method of guiding a ship into port by detecting electrically a cable laid in the bed of the channel, of which a description appeared in the April issue, had been anticipated by the experiments of Mr. C. A. Stevenson thirty years ago. M. Loth has now written in reply to Dr. Knott, but his letter is too long and his diagrams too technical to warrant their publication in full; the gist of his case, however, is given below.

The point at issue is: was it possible with the apparatus described by Mr. Stevenson in 1892 to guide a ship safely along a channel into port? M. Loth has examined the problem in detail and has concluded that it was not. He agrees that Mr. Stevenson's detecting apparatus will detect a cable's presence, but he declares the method as described will not allow a ship to be steered safely into port. There is, of course, a large difference between merely detecting the presence of a cable and accurately steering a ship by knowing where the cable is. Mr. Stevenson's description is too vague; he talks about his detector being on the ship, or *let down by rope or cable*, or *coiled round the hull of the vessel*. But this describes the detector too loosely, and a ship could not in fact be steered safely in this way. The problem is really complex and difficult, and several problems had to be studied and several difficulties to be removed, all subsequent to Mr. Stevenson's work, before the problem of guidance might be described as solved.

M. Loth declares that Dr. Knott, in putting forward Mr. Stevenson's claim to recognition, has mistaken the detection of a submarine cable for the solution of guidance. But really, unless the method leads to safe guidance, it cannot be said to anticipate his own work. And also, unless it does, it can hardly be said to have been novel in principle, even in 1892. For the detection of a submarine cable by electromagnetic means was first accomplished by Sir William Preece eight years before.

M. Loth declares that his own system of detecting a submarine cable is essentially different from Mr. Stevenson's and that his system allows ships to be safely guided into port, whereas Mr. Stevenson's does not and never has done. During the war the Admiralty did not use Mr. Stevenson's system because they did not think it safe enough for their ships; they adopted a very different system. M. Loth's system was, however, adopted by the French Admiralty.

BANANA SEEDS

To the Editor of DISCOVERY

SIR,

In the article *Sex and its Determination* in your August number, the following sentence occurs: "The banana, for instance, never sets seed." I used to think so too till 1881, when my teeth jarred on a banana seed and warned me ever since not to assume that your teeth will go safely through a banana. It is, I know, popularly assumed that the plant does not seed, and I have read eloquent accounts of it as one that has forgot to seed; but it is well known to botanists that the plant *does* seed, as will be seen from the following extracts from Alphonse de Candolle's *Origin of Cultivated Plants*:

Page 305: "No one pretends to have found in America, in a wild state, varieties with fertile fruit, as has happened in Asia."

Page 307: "The cultivated varieties seldom produce seed."

The first extract probably gives the cue to the myth of the banana not seeding, as those sold in this country all come from the West Indies. I myself lived many years in India before coming across the seed, and then not till I was sent to Bengal. Here I came across it three or four times altogether in eating the fruit, but I frequently used to see fine large bunches on plants growing on the embankments I had to look after, and used to wonder why the thrifty native of India did not gather them, till a rather comical incident revealed the cause.

I was travelling down a canal with my superior, and as we came to a lock he said: "I must get that bunch of bananas that I have noticed for some time"; and, calling out to the lockmen, he ordered them to bring him the bunch. Instead of a bunch with fine large fruits they brought him a miserable bunch of half-grown fruit. He got angry, refused it, and ordered a better one to be brought and, as there was some delay, he jumped out of the boat and, walking towards the plant he had seen, pointed in its direction while some distance away. The lockmen replied in a contemptuous tone, "Oh! that's a 'seeded' banana," and promptly ran off for the bunch, while my superior, seeing his ridiculous position, walked back to the boat, as he said, with his tail between his legs, while one of the men ran up to him with two or three bananas broken open to show that they were full of seeds.

The plant has been grown from seed, as will be seen from the following extract from Roxburgh's *Flora Indica*:

"In the course of two years from the seed received from Chittagong these attained to the usual height of the cultivated sorts, which is about 10 or 12 feet . . . and ripen their seed in five or six months afterwards," i.e. after flowering.

I kept a seed by me for a long time. It was somewhat smaller than the size of a broad bean, but more rounded with a projection at one side, black in colour, and about a twelfth of an inch thick.

Yours, etc.,

C. H. De Mello.

Riverside,
Castle Street, Salisbury.
August 1, 1922.

SECONDARY SEXUAL COLOURS AND STRUCTURES

To the Editor of Discovery

Sir,

Mr. Huxley, in his article on "Sex Determination" in the August number of Discovery, states that the female requires to be courted by the male in order that the sexual instincts may be stimulated, and definitely states that this requirement is the cause of the brilliant colours and conspicuous structures of many male animals.

As Discovery is largely read by the general public, it seems particularly undesirable that this very controversial consideration should be stated as if it were an established scientific fact.

A slight survey of the distribution of these sexual differences at once shows that female courtship is not the determining factor. Since in nature brilliant coloration is admittedly a danger to the wearer, it might be anticipated, according to Mr. Huxley's views, that the males of powerful or unpalatable animals would especially be free to exhibit this requirement for the courtship of females, because of their relative freedom from the attacks of enemies. Actually, the reverse is the general rule; it is among palatable and defenceless animals that the most brilliant males are to be found, whereas in unpalatable and powerful animals the sexes are usually alike. Compare, for instance, Crows, Kingfishers, Shrikes, Vultures, Geese, and Swans with Pheasants, Ducks, and Finches.

It is clear that some factor other than the requirement of courtship by females determines the occurrence and magnitude of secondary sexual differences.

Yours, etc.,

J. C. Mottram,
Director of the Research Department.

The Radium Institute,
Portland Place, London, W.
August 23, 1922.

SHELLEY'S BOAT, THE *ARIEL*

To the Editor of Discovery

Sir,

In the interesting article on "The Fate of a Great Lyric Poet," the boat built for Shelley is described (p. 185) as an open boat twenty-eight feet long, ketch-rigged. Later on, the *Ariel* is said to have been schooner-rigged (p. 210).

The illustration on p. 217 shows a yawl, and if the crew are drawn in anything like proportion, the length is more like forty-eight feet than twenty-eight feet. The tall mast, large sail area, and low freeboard suggest a decked yacht rather than a small open boat. Perhaps the vessel shown in the illustration is Byron's *Bolivar*, or it may be only a conventional representation of a British yawl yacht of the period.

Soundings on the chart may show if a boat could have been recovered from the bottom of the sea fifteen miles off Viareggio.

Yours, etc.,

John A. Stewart.

6 Clifton Place,
Glasgow.
August, 2, 1922.

[I am not prepared to lay down the law on what type of vessel the *Ariel* really was. Contemporary descriptions of the boat vary too much to allow anyone to make a final statement. In describing the boat as "ketch-rigged" I followed the writer of the biography of *Shelley* (in the People's Library), who appears to me to have considerable first-hand knowledge of sea-craft. The later reference to the boat mentioned by Mr. Stewart is contained in an extract from the Royal State Archives of Lucca, which certainly describes it as "schooner-rigged." As to its length, contemporary descriptions agree that it was twenty-eight to thirty feet.

The illustration on p. 217 was taken from Trelawny's *Recollections of the Last Days of Shelley and Byron* (Moxon, 1858), published during the author's life, and was accompanied by the following legend: "Captain D. Roberts, R.N., *del.* Villa Magni, Shelley's residence on the Gulf of Spezzia, A.D. 1822, with the boat (the *Don Juan*) in which he was wrecked." The *Don Juan* was the original name of the *Ariel*.—Ed.]

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Editorial Notes

ON the eleventh day of this month we celebrate the fourth anniversary of the Armistice. It is impossible to look back on the past five years without a feeling that civilised nations and civilised individuals have so far failed to cope with the collective and individual emotions resulting from the war. There is not a nation in Europe, excepting the Scandinavian countries, and Denmark, and one or two small states, that has not lost thousands of its citizens in war and revolution since the Armistice. Russia has been bled white with anarchy and famine; Poland has fought with Russian invaders and in her turn invaded Russian provinces; Germany has experienced two revolutions and has fought the Poles in Silesia; Montenegro has rebelled against Jugo-Slav domination and been subjected by force of arms; Spain has carried on protracted fighting in Morocco; France has defended her interests in Syria; England has lost thousands of her men in Russia, Mesopotamia, Palestine, and Egypt; there has been civil discord in Ireland and in Italy. Lately we have been faced with a most dangerous crisis in the Near East, brought about by the age-old hostility between Greeks and Turks.

* * * * *

This is only one side of the picture. The effects of war—unemployment, bereavement, sharp changes in social life, reaction after a life of strain and excitement—upon the individual have been overshadowed in the Press by these events affecting the general life of nations. We ask our readers to face the facts and put this question to themselves: "Do I know of a single family or a single individual who has come out of these last few years unscathed in mind as well as in body?" We feel sure that anyone whose lot it is to mix a great deal with his fellow human beings will give a negative answer to this question. From day to day he encounters war marriages which have not turned out successfully, pathetically neurotic men and women who have no aims in life except those pleasures which will take them away from its hard realities, people who have lost faith in their religion, who do not know where to turn in search of that thing by which men live—a philosophy to guide their actions—cynicism, uncertainty, despair, a revolt against traditions in social and political affairs, in art and literature.

* * * * *

War and its aftermath have been the direct and immediate causes of the present state of things, but only the immediate causes, only the agents which have matured the fermentation. In a sense we may consider all the present international chaos as mirroring the chaos in the minds of each one of us. On every hand there are signs of a conflict between the old order which wishes to return to the past and the new order which reaches out to grasp new ideals. But, however dimly we realise it, is not some such conflict taking place in our own minds? Are we not striving to get out of ourselves and expand into the world around us? And, surely, the sooner we as individuals can realise our essential similarity to every other individual, that what we dislike in others is really what we dislike in ourselves, that in losing ourselves in others we gain our true selves, the sooner will nations cease from mutual distrust and warfare. We urgently need "to take arms against a sea of troubles, and by opposing end them." The "slings and arrows of outrageous fortune" will then disappear from our own lives, and gradually from the life of the world. Neither reaction nor revolution will carry us out of our present difficulties, but an orderly progress based on each individual giving himself in work, sympathy, and love to his fellow men.

Gliding Flight

By "Rafex"

THE remarkable performances of certain German gliders starting from the summit of the Wasserkuppe in the Rhone valley during the last two years have aroused popular interest in a subject which is difficult to assess at its true importance. It is, of course, the fact that the progressive gliding experiments of Lilienthal, Pilcher, Chanute, and others led directly to those of the Wright brothers, which in their turn resulted in the invention of the first successful power-driven aeroplane; and therefore the aeroplane may be said without question to owe its birth to gliding. On the other hand, it is at least debatable whether we have not now got beyond the stage where anything further can be learnt by such embryonic flying machines, and have not advanced to the point where laboratory experiments, checked by full-scale tests, provide the true scientific road to further development. Be that as it may—and we will return to the subject later—no consideration of the sport, or science, of gliding can hope to be complete without a brief outline of the achievements of the pioneers, which gives a measure of the merit of recent advances as well as a glimpse of the foundations upon which all modern progress has been built.

The "father" of all gliding was Otto Lilienthal, whose first experiments, with flapping-wing models, were made at the early age of thirteen. It is an interesting example of the tortuous path frequently followed by scientific development that his later gliding experiments, which were perhaps the first practical step towards the modern aeroplane, were intended by him as a preliminary to the production of an ornithopter. He realised the importance of overcoming the difficulty of maintaining equilibrium in the air, and for this purpose made many glides with fixed wing machines, but he does not appear to have visualised the aeroplane of which they were the precursors. Lilienthal started in 1891 by making jumps from a spring-board in the garden of his house at Lichtefelde, on the outskirts of Berlin. During the next three years he tried several suitable mounds in the neighbourhood and made many short glides over a gravel pit on the edge of which he had built a shed, from the top of which the jumps were made. In 1894 he had a small hill 50 feet high specially constructed from a mound of earth, with a shed for housing the gliders sunk in the top. Shortly afterwards he moved to his final experimental ground among the sand-hills at Söllen.

Lilienthal's gliders were of the simplest possible form with no mechanical means of controlling the balance. The earlier types were of monoplane design with the wing on each side stiffened by wooden ribs, radiating from a point near the operator's shoulders, who occupied an upright position with his weight carried on padded supports under the armpits. Balance was maintained entirely by moving the legs to alter the position of the centre of gravity. A horizontal fin was fitted at the rear which gave some automatic fore-and-aft control, as it was designed to yield slightly in an upward direction under the influence of wind-gusts. Above this horizontal surface was a vertical fin which was not movable. In spite of the crudity of this method of maintaining balance, Otto Lilienthal succeeded in making glides of over 1,100 feet, starting from a point 150 feet above the surrounding plain. In his own account of these glides he says[1]: "I often reach positions in the air which are much higher than my starting-point," and, "At the climax of such a line of flight I sometimes come to a standstill for some time, so that I am enabled while floating to speak with the gentlemen who wish to photograph me." There does not appear to be any record of the actual time he remained in the air on any of his glides, but enough has been said to show that he appears to have had considerable control over the balance of his machine simply by moving his body. The biplane gliders, on which his later experiments were made, were in all essentials precisely the same in principle as the monoplanes. They had a total wing surface of about 200 square feet, with a span from wing-tip to wing-tip of 18 feet, which enabled him to glide straight off the top of the hill "almost horizontally," without any preliminary jump, in a wind of 20 miles per hour. Lilienthal unfortunately met his death while gliding on Sunday, August 9, 1896, but not before he had shown the way to other practical experimenters and obtained much laboratory information of inestimable value on aerodynamics.

The mantle of Lilienthal fell on Percy Pilcher,[2] a young English naval architect and marine engineer, who took up gliding in 1895, when he built his first machine. He visited Lilienthal in the same year and made one or two glides on the German's biplane glider. Pilcher, however, preferred the monoplane, and all his own machines were of that type. Fig. 1 shows him in the air on his most successful glider named the "Hawk," which bears a striking resemblance in general outline to Lilienthal's monoplane and was undoubtedly influenced by the visit to Germany. It had a supporting surface of 180 square feet with a span of 23 feet 4 inches and chord of 8 feet 4 inches, the overall length being 18 feet 6 inches. It was con-

[1] *The Aeronautical Annual*, No. 2 (1896), p. 16.

[2] *The Aeronautical Classics*, No. 5: "Gliding," by Percy Pilcher.

structed of bamboo covered with linen and only weighed 50 lb. This machine on Pilcher's death came into the hands of the Aeronautical Society of Great Britain (now the Royal Aeronautical Society), of whose Council he was a member, and is now deposited in the Scottish National Museum at Edinburgh on permanent loan. Pilcher made many glides on the banks of the Clyde near Cardross, and at Eynsford in Kent. His best glide was made at Eynsford in June 1897, when he started from the top of a hill, glided right across the valley at a considerable height, and landed safely on the opposite hill after a flight of over 250 yards. Pilcher also became a martyr to gliding, on Saturday, September 30, 1899, when the tail collapsed and he fell to the ground from a height of 30 feet in the grounds of Stanford Hall, Lord Braye's seat at Market Harborough.

The next step in the development of gliding was effected by Octave Chanute,[1] an American who began experimenting in 1896 near Chicago. After building a Lilienthal-type machine he came to the conclusion that the German and Pilcher were on wrong lines in relying on movements of the body for the maintenance of balance, and evolved the principle of so arranging the wings that they automatically moved under the influence of a gust, returning to their original position under the action of springs after the gust had passed. In his early machines this was done by allowing the wings to fold slightly backwards, but in the later types they were pivoted round the fixed front edge so as to permit the rear edge to yield in an upward direction. Chanute also realised the importance of the theories of Alphonse Pénaud, who as early as 1877 had discovered the balancing effect of having a tail set at a less angle than the main wings, which introduced a longitudinal "dihedral angle." The "Pénaud tail," which is in principle a feature of all modern aeroplanes, was first incorporated in a man-carrying machine by Chanute. Many thousands of glides were made in Chanute's gliders between 1896 and 1903 without accident, and these may be said to have led directly to the successful experiments of the Wright brothers.

Before proceeding to their work, however, mention must be made of a pioneer whose work is in some respects more remarkable than any of those we have mentioned, although it seems to have become almost forgotten, and few people in this country appear ever to have heard his name. This was Professor J. J. Montgomery, and it is sufficiently remarkable that he claims[2] to have glided a distance of 600 feet so long ago as 1883—nearly ten years before Lilienthal. But his chief claim to fame is his remarkable success at a later date in solving the problem of automatic stability. After devoting nearly twenty years to laboratory experiments and tests with models he, in 1903, again built a full-scale glider which had arched wing surfaces, the extremities of which could be pulled down, or "warped," by cords at the will of the operator; whilst in rear was a large elevator. With this machine the most remarkable feats were performed by three professional parachutists whom Montgomery engaged to demonstrate the principle. In 1904 one of these parachutists, Maloney, made a glide which it would be difficult to equal even at the present day. He was raised by a balloon to a height of 3,000 feet when he

FIG. 1.—PERCY PILCHER ON HIS LILIENTHAL-TYPE GLIDER THE "HAWK."
From a snapshot taken in 1896.

cut himself adrift. "As he cut loose [from the balloon] he lost his direction. We told him to come back to the starting-point. He started to fly towards a distant city. In five or six minutes he detected his mistake, turned round, and started to fly towards us. . . . Finally, he came back near the point of starting. He could not make the exact point for he had lost a great deal of elevation . . . so he made a circle and came to the earth."[3] On another occasion in the same year Maloney, "in trying to make a very short turn during rapid flight pressed very hard on the [wing warping] stirrup and made a side somersault. After this movement, the machine continued on its regular course. And afterwards Wilkie, not to be outdone by Maloney, told his friends he would do the same, and in a subsequent flight made two side somersaults, one in one direction and the other in an opposite."[4] After reading this one has to rub one's eyes and remember

[1] *The Aeronautical Annual*, No. 3 (1897), p. 30; and *L'Aérophile*, vol. xi (1903), p. 171.

[2] *Aeronautics*, vol. iii, p. 63.

[3] Ibid., p. 64.

[4] *Vehicles of the Air*, by Victor Lougheed, p. 144.

that these experiments took place about the time when the brothers Wright were perilously edging round corners on their first power-driven machine and inquiring into the mystery of its tendency to side-slip and "stall" while doing so. A further commentary is afforded by the accident in September this year to Herr Klempferer, one of the most successful present-day exponents of gliding in Germany, who was released in his glider from a kite-balloon at a height of 4,000 feet and fell to the ground without gaining control of his machine.

In view of these amazing performances, which are well authenticated, it seems extraordinary that one has never seen a reference to Montgomery in any of the numerous articles on gliding which have been published recently.

It is not proposed to deal here at any length with the work of Wilbur and Orville Wright which eventually led to the successful development of the aeroplane as we now know it, since a detailed account already exists in a readable and accessible form.[1] But readers of DISCOVERY may probably not be aware of the fact that in 1911 Orville Wright set up a world's record for soaring by remaining in the air over the same spot for 10 minutes 1 second, which possibly remains unequalled as a demonstration of control by all the long gliding and circling flights, up to three hours in duration, made in Germany during August this year.

The improvement in performance, so far as time spent in the air and distance covered are concerned, is due to the advance that has been made in the intervening years in the aerodynamic efficiency of machines, combined with the increased skill of the pilots. It must be remembered that the pioneers were using gliders in the effort to teach themselves the art of maintaining equilibrium in the air. The present-day experimenter, on the other hand, comes to the sport with all the accumulated experience of many hundreds of hours spent in the air in aeroplanes, and the resulting confidence, and knowledge of what to do in an emergency. So far as concerns the efficiency of machines, even down to the days of the Wrights, little was known of the characteristics of wing-forms or the amount of resistance offered by different-shaped bodies. And yet these are points of vital importance to the gliding angle of the machine, which decides how many feet it will travel forward for each foot it drops towards the earth under the influence of gravity. In the average aeroplane of to-day this rate of descent, with engine cut-off, is in the neighbourhood of 1 in 11, while some of the most successful recent German gliders are said to have a gliding angle of 1 in 16 in calm air compared with the 1 in 6 of Lilienthal. In its simplest form gliding is analogous to "coasting" on a bicycle down a steep hill, the slope being provided in the case of the glider by the passage of the air along the wings. In the more complicated examples of gliding flight it is important to remember this cardinal principle: that the machine is always gliding downwards *through the*

FIG. 2.—A MODERN GERMAN GLIDER.
Showing the type of country suitable for gliding.

[1] *The Life and Work of Wilbur Wright*, published by the Royal Aeronautical Society, London.

air even though it may be rising in relation to the ground under the influence of an up-current of wind. That is why the selection of the site is so important for gliding experiments ; because the duration of the glide may, by a skilful pilot, be prolonged by taking advantage of the up-currents which are to be met with on the windward side of hillocks or small inequalities in the ground with the wind in certain directions. In the Wasserkuppe region in Germany, where such remarkable results have been achieved, the ground towards the south falls away rapidly in a smooth slope which is admirable for simple glides. But it is on the west that it is most favourable for spectacular performances, though even there only when the direction of the wind is also from the west. This enables the glider to get into an up-current immediately on leaving the ground, through which he can gain sufficient height to enable him to circle and make for a series of low hills at the foot of the main slope, which each possesses characteristic wind eddies and currents which can be turned to advantage. As a result of a careful study of these local currents over many years—this country was first used for gliding in 1912—the German expert gliders are enabled to put up performances which could only be equalled elsewhere after prolonged study of local meteorological conditions.

True "soaring" flight, if such be possible, does not appear yet to have been achieved in the sense in which birds are said to soar : by which is meant effortless horizontal flight under conditions where no up-current—whether arising from configuration of the ground or from the heating of the air by the sun's rays—appears to exist. Various theories have at different times been advanced for this phenomenon, the most probable of which is that, even in an apparently steady horizontal wind blowing over the surface of a perfectly flat plain, there are regular or irregular pulsations, the vertical component of which a bird is able to turn to account by minute adjustments of the angle of its wings. An attempt is being made to test this theory in certain special gliders which have recently been built in Germany. The rear edges of the wings are free to move up and down against helical springs, which it is hoped will enable them to adjust themselves rapidly to these supposed pulsations, and so take advantage of their effects. Whether or not this will be successful remains to be seen, but to a student of the past it seems strangely reminiscent of Octave Chanute's system for maintaining longitudinal equilibrium, and one cannot help feeling that, after allowing for all the aerodynamical development that has taken place in the meantime, there must be more in it than that or he would have discovered it.

It is, as has already been hinted, impossible, in the writer's opinion, yet to say whether or not gliding has a utility as a means of scientific observation midway between the laboratory and the full-scale aeroplane. The chain between the two is admittedly not yet complete, but the facilities for observation in a glider would appear to be limited, as the operator is fully occupied with the maintenance of his position in the air. This difficulty might, it may be said, be overcome by carrying a passenger to do the observing, but he would not have the intimate "feel" of the machine that the pilot has. On the other hand, the weight of the necessary recording instruments for taking mechanical observations of the phenomena would be very considerable and likely to be prohibitive.

Whether or no the glider proves a scientific instrument, it certainly provides a cheap and attractive way of gaining a knowledge of the air ; with the proviso that extrication cannot be made from a difficult position by switching on the engine, as in an aeroplane, and the most dangerous situations are likely to occur where there is little or no air-space below in which to recover.

The Fear of Death

By F. A. Hampton, M.B., M.C.

THE average man is wisely too preoccupied with life to be much concerned with the idea of death ; in fact it may be doubted whether the idea of death as such plays any significant part in the life of the normal individual, for it would seem to be very difficult for man to form a subjective idea of death, that is, to imagine himself either as having ceased to exist or (the slightly easier alternative) as existing in some fashion outside his material surroundings. If we assume that the mind was evolved not in order to enable man to think, but to enable him to act more efficiently, then it is not surprising that it should prove inadequate to so sterile and useless an activity.

A situation that threatens life, or the anticipation of such a situation, may fill us with fear, and it is well for our self-protection that it should do so ; but if we examine this fear it is rare to find that it contains any conception of death, and we can hardly say that a distinct fear of death stands out from the general protective emotion of fear evoked by any circumstance that threatens injury or destruction.

The late war provided situations enough of this kind, and if we inquire into the feelings of those who were exposed to them, we find that the fear was rather of the immediate physical violence than of its

possible results, and if death came into consideration at all, it was usually thought of as an escape from a situation that was almost physically unbearable. This attitude is well described in the following passage from *The Diary of a Dead Officer*, by the late Arthur Graeme West. The passage was written immediately after a heavy bombardment, and the sensations recorded are typical of those of many others in like circumstances. "After we had been shelled for about two and a half hours on end my nerves were shaky and I could have cried for fright as each shell drew near, and longed for nothing so much as to rush down a deep cellar. It was merely consideration of the simple fact that a shell, if it did hit me, would either wound or kill me—both of which were good inasmuch as they would put a pause to this existence—that kept me up to my standard of unconcern. And the more I experience it, the more fear seems a thing quite apart from possible consequences. I feel afraid at this moment. I write in a trench that was once German, and shells keep dropping near the dug-out. There is a shivery fear that one may fall into it or blow it in. Yet *what* do I fear? I mind being killed because I am fond of the other life, but I know that I should not miss it in annihilation. It is not that I fear."

This reaction to a situation threatening death becomes more comprehensible when we remember that fear is a self-protective emotion giving us alertness to beware of danger and wings to escape from it. The animal reacts to danger without, it may be supposed, being aware of the possibilities of harm involved, and man appears to react to danger in a similar way, as we have seen in the case quoted above. For although man is aware, and often acutely aware, of his danger, yet the intensity of the fear experienced does not appear to be always quite proportionate to the extent to which his life is threatened; for example, people were more fearful of air-raids than of the influenza epidemic, although the latter was by far the more deadly of the two. In this instance the air-raids were a prepotent cause of fear because, presumably, they evoked the emotion through its most primitive channel of stimulation, that of threatened violence; it is useful for an animal to feel frightened at violence, but to experience fear from a feeling of illness would serve no purpose.

Against all the foregoing it may be said that it is a truism that we are afraid of death, and to gainsay it is mere sophistry and playing upon words; but the above considerations seem to lead to the conclusion that we have focused upon the idea of death, or, more strictly, upon the idea of dying, a general protective emotion of fear that does not properly belong to it, and that we have, in imagination, endowed death with a fearfulness that reality does not substantiate. And it seems not impossible that by looking at death from this angle we may divest it of some of the terror that, at least in words, we attribute to it. Indeed, if we allow ourselves to examine this idea of terror, it seems to have an archaic, almost superstitious, quality, and to be incompatible with the calmness with which ordinary men and women, of no particular courage or stoicism, may be observed to meet it.

This introduces the idea already suggested, that, when we speak of the fear of death, we are commonly thinking of the idea of dying, and here it must be borne in mind that, although death may be an undiscovered territory, yet we may claim to know something about dying. For we have on record the experiences of many people who, from drowning, asphyxiation, or other causes have sunk into a state of unconsciousness that, had it lasted but a little longer, would have passed the limit of recoverability and ended in death. These experiences show a remarkable agreement in the absence of fear and even of discomfort: in many cases there is a feeling of lightness and freedom, sometimes of travelling with great speed, sometimes of complete tranquillity that is almost pleasurable. We may quote in this connection the last words of William Hunter, the great anatomist: "If I had strength enough to hold a pen I would write down how easy and pleasant a thing it is to die."

In a similar way the certain expectation of death seems to contain little of the terror with which our imagination tends to endow it. Dostoevski, the Russian novelist, standing on the scaffold awaiting execution, and with no idea that he might be reprieved, calmly calculated exactly how many minutes he had to live and seemed to be preoccupied with an almost purely intellectual interest in the great amount of "living" that could be done in a short space of time. A man who marvellously escaped after falling off a tall building seemed to have felt little during his descent except a mild wonder at the length of time he was taking to reach the ground.

There is no reason to suppose that these experiences are exceptional except in that they were recorded, and we are entitled to assume that they represent the normal sensations that accompany the final vanishing of consciousness and the typical attitude in the expectation of death.

The fact that our conception of dying is derived from our observation of the process of death in others, rather than from the necessarily rare data that we have spoken of above, probably accounts for some ideas that are commonly held, but are certainly incorrect, notably for the idea expressed in the phrase "the agony of death." The word "agony" seems to have come into the language from the New Testament

where the Greek word "ἀγονία"[1] (literally, "a struggle") is used to describe the spiritual conflict of Christ in the garden of Gethsemane; it came to be employed (as it is now almost exclusively in French) to describe the act of death, possibly because the spasmodic twitchings that are sometimes observed to occur at the point of death, though long after the loss of consciousness, were imagined to be the physical result of the soul struggling to leave its habitation. It is but comparatively lately that the word acquired its present commonest meaning of great pain, thus colouring our conception of dying—and not only in old wives' tales—with an idea of pain and distress that, as has already been remarked, reality does not substantiate.

We have said that in the life of the average man the conception of death, of his own death that is, plays little part; but there are many who seem to be oppressed by the sense of their own mortality, and as they are commonly reflective and thoughtful people, and were at one time numerous among the preachers and moralists, there is a tendency to give them credit for penetrating beneath the surface of life and reaching some sort of fundamental truth, unfruitful and obvious though it be. The attitude of such an individual towards life tends to be that of a critic or spectator; it is an attitude of self-consciousness, for he sees himself in relation to life and as it were standing apart from it.

This attitude is well pictured in the following dream: "I was standing on an incline beside a kind of great moving staircase on which were all sorts of people, many of whom I knew. They were all walking and being carried upwards. I was the only one who was not on the moving stairway. I felt very insecure, and at times I seemed to be slipping downwards." The dreamer went on to say, "This is rather like what I feel when I am awake. Other people seem to be going ahead and moving with the stream, but I am standing still."

The same individual occasionally had a nightmare in which he felt that he was slipping down a smooth incline towards some sort of abyss—a dream that proved to be a dramatic representation of the fear of death from which he suffered in waking life.

If we are able to investigate a personality of this type where a fear of death, or its slighter degree of a sense of mortality and impermanence, is coupled with the attitude of standing outside life, we often find that at the bottom it is a fear of life itself that enforces an attitude of aloofness and detachment. On further investigation we find in many cases that the fear of life is directed against one special aspect of it, against the sexual side of life, and in dreams we find love and death linked together as objects of fear. This becomes more understandable when we realise that the reproduction of life is, on the biological level, antagonistic to the life of the individual; when reproduction is accomplished the biological goal is reached, and in many of the lower animals death follows immediately. Some hint of this may persist in the sense of finality and the dying down of an impulse that accompanies the achievement of any end, especially one so ardently pursued as that of love. There is a Spanish proverb, "When the house is finished, Death enters in," and Sir Thomas Browne, speaking of marriage (in anticipation, it may be noted), says: "Thus I perceive that a man may be buried alive and behold his grave in his own issue."[2]

The psychological equivalent of this biological antagonism is a deep unconscious conflict between the egoistic impulses and the sexual instinct; a conflict understandable enough since a great passion may overwhelm an individual, transcend all his old values, and commit him to acts of self-forgetfulness of which he had believed himself incapable. In a slighter and more subtle way the conflict may appear as reluctance to admit another within the circle of the personality:

> "Love is a breach in the walls, a broken gate,
> Where that comes in that shall not go again;
> Love sells that proud heart's citadel to fate."[3]

This reluctance seems to arise partly because there is a feeling of safety in keeping something at least of the personality secret and inviolate, and partly because for one individual to admit another entails transferring to him or her some of the love previously attached to the self. This aspect of the conflict is admirably expressed, from the man's point of view, in D. H. Lawrence's last novel, *Aaron's Rod*, and in it is also expressed what appears to be our solution of the conflict. For man seems to endeavour to reach beyond the biological goal of love, (thus robbing it of the aspect of finality), towards some enduring intimacy that shall abolish the deep feeling of loneliness and isolation that his highly developed consciousness has inflicted upon him as the price that he must pay for its advantages.

It is interesting to notice how common in poetry is this theme of mortality and the transience of all things beautiful and desirable:

> "Beauty vanishes, beauty passes;
> However rare—rare it be."[4]

And there is perhaps a tendency to assume that such a view of life is the inevitable result of any steady

[1] New Oxford English Dictionary.

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[2] *Religio Medici*, part 2, sect. 14.

[3] Rupert Brooke. (*1914 and Other Poems.*)

[4] Walter de la Mare. (*The Listeners*, etc.)

and clear-minded reflection upon it, and to forget, in the beauty and perfection of its presentation, that such a view is essentially the idiosyncratic expression of a particular temperament ; for this regret over the fleetingness of life seems to be a projection on to external things of the writer's uneasy feeling of his own mortality, and in the older poets the general "moralisation" often leads on naturally and naïvely to some such personal reflection as :

> " Thow I be of muchê prise,
> Fair of face and holden wise,
> Mine fleich schall faden as flour-de-lys
> Whan I am ded and leid in cley." [1]

It is not the love of life, but the fear and the renunciation of life, that begets the fear of death, and it is significant that the Abbot of a Benedictine Monastery, writing recently in the Chronicle of his Order, records that the greatest difficulty which he has to combat in securing the peace and tranquillity of mind among the monks under his charge is the fear of death.

The temperament that holds itself aloof from life merges into the neurotic, and in this sphere we find the fear of death occurring fairly frequently as a symptom and from various causes, but they are of more technical than general interest, and are fully dealt with in the textbooks of psychopathology.

We have tried to show that, firstly, the fear of death is largely compounded of the fear of dying, upon which we have, in imagination, concentrated a generalised instinctive reaction to danger and especially to violence. We are entitled to say "in imagination" because, except in comparatively rare cases, neither the imminence nor the process of death seems to cause fear. Secondly, that a sense of mortality, that is tolerably common and easily deepens into a fear of death, is the expression of an inadequate reaction to life.

But over and above there remains a fear of death as the unknown, and the unknown is of itself a powerful cause of fear, especially in primitive races. But, with increasing mental development and with the growth of intellectual curiosity, the unknown as such loses its capacity for inspiring terror ; it is an instinctive form of fear that belongs essentially to the childhood of man and to the childhood of the race, and one day, perhaps, it may be to a great measure outgrown, and the traditional "philosophic" attitude towards death become common to everyone. Meanwhile, as an example of such an attitude, we may do worse than take the fine common sense of Mantaigne : "I would have a man to be doing and to prolong his lives offices as much as lieth in him, and let death seize upon me, whilst I am setting my cabiges, carelesse of her dart, but more of my unperfect garden." [2]

[1] Author unknown. MS. of the beginning of fifteenth century. (*Early English Lyrics.* Chambers and Sidgwick.)

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Inflation and Unemployment

By Douglas Knoop, M.A.

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Records extending over a considerable number of years show that before the war the state of trade in the principal industrial countries tended to be alike. When trade was good in the United Kingdom, it tended to be good simultaneously throughout Western Europe and the United States, and similarly when trade was bad. Since the war, this tendency to similarity of trade conditions in different industrial countries no longer holds good ; the striking contrast during the last two years or so between trade conditions in the United Kingdom and those in Germany has been a matter for general comment. The cause of the difference almost certainly lies in the fact that Germany continued to pursue a policy of inflation after it had been given up in this country. If inflation has such a favourable influence on trade conditions and on the state of unemployment, it may not unreasonably be asked, "Why should not we adopt the same policy in this country ?" The object of this article is to examine the connection between inflation and trade conditions, with a view to showing why a policy of inflation is not to be recommended as a method of dealing with unemployment.

Inflation consists in increasing the amount of currency in circulation in excess of that which is needed to perform the transactions of the community. So long as a country's currency is based on a genuine gold standard, i.e. so long as its paper money is immediately convertible into gold and so long as that gold may be melted down or exported without restrictions, there can be no real question of inflation. It is true that the amount of credit instruments may be increased somewhat, but the total amount of credit that can be erected on a given quantity of currency

is more or less limited. If currency or credit instruments are multiplied beyond requirements, then gold from the currency will be exported, hoarded, or utilised for industrial purposes, and the total amount of currency and credit instruments available for making payments will thus be automatically reduced. Once all the gold has been drained out of the currency, or once the real convertibility of the paper money has been abolished, then the automatic check on the continued existence of excessive supplies of currency and credit instruments disappears, as paper money which is not immediately convertible into gold is not readily acceptable abroad in large quantities, except possibly for speculative purposes. Additions to the currency tend to remain in the country of issue, together with the credit instruments which can be based on the additional issues. The supply of currency and credit instruments available for financing business becomes much larger than would have been the case had the currency still been based on a genuine gold standard. As a consequence, the exchanging power of each unit of currency tends to fail, or, in other words, the price of commodities tends to rise.

An increase in the general level of prices leads to a demand for more currency to enable trade to be financed at the new price levels. If additional currency is issued, it tends to cause prices to rise still further, thus leading to renewed demands for more currency. Unless a very determined effort is made to break the vicious circle, the rise in prices and the increase in the amount of currency tend to grow at ever accelerating rates.

Under normal conditions, when the general level of prices in a particular country rises, whilst prices in the rest of the world remain more or less constant, imports into the country with rising prices tend to increase, and producers in that country find it more difficult to sell goods both at home and abroad. When, however, prices in a particular country rise on account of currency inflation, the consequences are quite different ; sales of that country's produce both abroad and at home are greatly encouraged, and imports are discouraged. Foreigners are keen to buy, because they find that they can thus secure goods more cheaply than at home. This is due to the fact that when a country adopts a policy of inflation, the prices of commodities tend to rise more slowly than the prices of foreign currencies. E.g., in Germany £1 may rise in price 300 times from 20 marks to 6,000 marks, whilst the price of a particular commodity rises only 150 times from 20 marks to 3,000 marks. In England the price of the commodity remains unchanged at 20*s*. Then an Englishman with £3 to spend can either buy three articles at 20*s*. at home, or can exchange his £3 for 18,000 marks and with that can buy six articles at 3,000 marks. Inflation, although it leads to a rise in prices in terms of home currency, makes goods cheaper in terms of foreign currencies, and thus encourages exports.

Inflation also encourages sales at home, but for a different reason. Residents in a country with a rapidly depreciating currency are anxious to buy commodities of all sorts—so far as their means will permit—in order either to spend the money on present enjoyments whilst it still has the same purchasing power, or to secure durable commodities which do not immediately deteriorate in value if they are kept for a time. To keep one's surplus resources lying on deposit at a bank in countries like present-day Germany or Austria is analogous to keeping beer in a barrel that leaks : the deposit, so far as its purchasing power is concerned, steadily diminishes. Owing to rapid depreciation, home currency ceases to be a satisfactory store of value, and there is consequently a very strong inducement to spend it promptly, which is likely to stimulate home trade for the time being. It does not necessarily follow, however, that the bulk of the currency spent is devoted to the purchase of goods ; stock exchange securities may prove the attraction, especially ordinary shares in industrial undertakings. Indirectly these purchases help industry by facilitating the raising of additional capital. On the other hand, the holders of depreciating currency, instead of buying goods or securities, may buy foreign currencies, which does not benefit industry. This tends to occur more frequently in the later, than in the earlier, stages of inflation, and will be referred to again below.

During the early stages of inflation producers find ready markets for their goods both at home and abroad, trade flourishes and unemployment falls to a low point. There is, however, another side to the picture which is a good deal less pleasant ; the trade prosperity is artificial and is secured only at a heavy price. It is this price which we must now examine.

The constantly rising prices associated with inflation affect various sections of the community differently, according to the source from which the income is derived.

(1) In the worst position is the rentier, more particularly the person who derives his income from fixed-interest bearing securities ; the purchasing power of his fixed income is constantly diminishing. Thus many people in Germany and Austria who possessed a modest competence before the war are now virtually paupers. Very similar in practice is the position of a person who derives his income from the rent of land and buildings, though in theory he should be much better off, as rents should tend to increase with the rise in the general level of prices.

In practice, however, Governments intervene and pass some kind of Rent Restriction Act which prevents landlords from raising rents to anything like the same extent as prices have risen. As a consequence, the rentier who derives his income from rents is nearly, if not quite, as badly off as the rentier who derives his income from fixed-interest bearing securities. A person whose income comes from dividends on ordinary shares is in a different position, analogous to that of a business proprietor, and he may best be considered as such.

(2) In a distinctly better position than the rentier are the persons who earn wages, salaries, or fees, as there is a probability that they will be able to secure increases in remuneration which will more or less compensate them for the rise in the general level of prices. It is fairly safe to conclude, however, that these increases in pay will compensate them less, rather than more, for the rise in prices, as the old saying that "wages follow prices" contains a very large element of truth. At the very best, wages and salaries may be adjusted automatically in accordance with a scale based upon changes in the cost of living, but unless the calculations and the adjustments are made very frequently, the increases in wages will always lag behind the increases in prices, which will be a serious matter where prices are advancing at all rapidly. In the case of many wages and salaries, and more particularly in the case of fees, it is improbable that sufficiently prompt and adequate alterations can be made to maintain real incomes, in terms of commodities and services, at the old level.

(3) In the best position, in any case during the earlier stages of inflation, are the proprietors of business undertakings. This applies to the owners of private enterprises—farms, shops, factories, etc.—as well as to the ordinary shareholders of industrial and commercial companies. Selling prices tend to rise more rapidly than do costs of production, the interest charges being comparatively fixed and the wages bill tending to lag behind. Thus the margins between costs of production and selling prices tend to grow, and so consequently do the profits. Furthermore, the prices of all stocks held tend to increase, which helps to swell the profits. Thus inflation appears greatly to benefit the proprietors of business undertakings, even as it prejudices rentiers and the earners of wages, salaries, and fees. In reality, inflation is just as harmful to business proprietors as it is to other sections of the community, only it is necessary to look below the surface to discover the damage that is being done. Inflation causes business proprietors to use up their fixed and their working capital, but so long as the capital lasts, the losses that are really being incurred tend to be hidden by the favourable figures—expressed in terms of paper money—which fill the balance sheets.

We may first examine the insidious attack which inflation makes on fixed capital; it takes the form of causing the provision for depreciation to be hopelessly inadequate. In a soundly conducted business, a sum, based on the estimated life of the plant, is charged as an expense each year against revenue, before ascertaining profits, in order to provide in due course for the replacement of worn-out plant. Thus if new machinery costing 1,000,000 marks had an estimated life of 10 years, the manufacturer would set aside each year 100,000 marks to provide for depreciation. At the end of 10 years he would have set aside 1,000,000 marks with which to replace the machinery and thus maintain his capital intact. If during the 10 years prices rise enormously owing to inflation, the 1,000,000 marks accumulated in the depreciation fund will prove utterly inadequate to defray the cost of replacing the worn-out machines. The bulk of the capital originally represented by the machines will be lost, the loss having occurred through the manufacturer charging his customers too little in respect of the use made of the machines.

In what concerns working capital which is employed for financing stocks of raw materials or other commodities required in connection with production, it is found that, owing to the great rise in prices, the money realised when the stocks are disposed of is not sufficient to pay for renewing the stocks. Thus, although handsome profits are made, in terms of paper money, every time goods are sold, in reality a loss is being incurred, and the firm's real capital, in terms of commodities, is being reduced.

Living on capital is not a course which business firms can follow indefinitely, though the evil day of a collapse can be postponed for a time by issuing new shares or by raising loans. If inflation continues to grow, the new capital will be lost like the old, and a time must come when people will no longer be willing to invest money in industrial undertakings, assuming they have any to invest; this will certainly not be the case so far as the rentier class is concerned, which normally does a considerable share of the national saving.

For a time, successive doses of inflation cause trade to be brisk and employment good at the expense of ruining the rentier class, of prejudicing wage-earners and seriously prejudicing the salaried and fee-earning classes, and of gradually undermining the position of business proprietors by causing them to live on capital. "Good trade" based on this kind of rake's progress cannot continue indefinitely. (1) The most prompt reaction will be brought about by the adoption of a policy of currency deflation. Czecho-Slovakia

appears to be suffering at present from acute trade depression and unemployment for this very reason. (2) The mere stopping of inflation, without any attempt at deflation, will also bring about a complete change in trade conditions, though rather more slowly. The prices of commodities will tend to catch up to the price of foreign currencies, thereby cutting off the automatic bonus which had previously encouraged exports. Wages will tend to catch up prices, thereby eliminating an important cause of producers being able to sell cheaply. Sales both at home and abroad will be seriously reduced and employment will suffer accordingly. (3) If inflation is continued in ever-increasing doses, the evil day of a collapse in trade can be postponed a little longer. Nevertheless, a change in trade conditions will come in spite of inflation ; the factors which are likely to bring it about being as follows :

(i) The growing difficulty, if not impossibility, of obtaining sufficient credit from banks or capital from investors with which to finance trade. In terms of paper money, the sums required will be so enormous that the means to provide adequate advances will be lacking, even if the will to lend still exists.

(ii) The diminishing home demand for goods, brought about by an increasing tendency to employ any surplus available in the purchase of foreign currencies in preference to buying goods or industrial securities. Export restrictions may prevent goods being sold to the best advantage ; shares may become worthless owing to the collapse of business ; foreign currencies appear to offer the best prospects of appreciating and of being realisable in case of necessity.

(iii) The growing difficulty of financing abroad purchases of essential raw materials and food products. In the early stages of inflation, considerable funds for this purpose are secured by the sale to foreigners of currency and securities which they buy for speculative purposes in anticipation of an improvement in the exchange. When foreign speculators lose confidence in the ultimate recovery of the depreciated currency, this source of financing necessary purchases abroad dries up.

(iv) The growing disorganisation of the national finances, due to the absence of any steady basis on which to levy taxation.

(v) The growing difficulty of conducting trade in terms of the rapidly depreciating currency. Business will tend to be conducted in terms of foreign currencies or by means of barter. In a relatively self-supporting agricultural country, with a comparatively small trade, this might not matter very much, but in an industrial and commercial country largely dependent on trade, the practical elimination of a home currency system cannot fail very materially to diminish the amount of buying and selling, thereby correspondingly reducing employment.

The cumulative effect of these various hindrances to trade, when once they have begun to make themselves felt, as appears now to be the case in Germany, can hardly fail to bring about a most unfavourable state of affairs in a comparatively short time. In Austria the stage of trade stagnation and collapse has already been reached ; there inflation has lost its power to stimulate trade.

The stimulating effect of inflation on trade can best be compared with the stimulating effect of cocaine, or some similar drug, on human beings. It has to be applied in constantly increasing doses if it is to continue to stimulate, until ultimately the patient collapses from an overdose. Thus the final effect of inflation is to kill trade and to bring employment practically to a standstill in an industrial and commercial community.

The Attack on Mount Everest[1]

By R. N. Rudmose Brown, D.Sc.

THE attack on the summit of Mount Everest (29,002 ft.) began in 1921, when Col. Howard-Bury led a reconnaissance expedition whose aim was to discover the best route by which the final attempt could be made. Little accurate information about the regions lying around Mount Everest was available. Approaching from Tibet, the explorers found that the Rongbuk glacier, which seemed the obvious line of approach, afforded no practicable way, and that the western slopes of the mountains were unclimbable. Attack from the Kharta valley on the east seemed to be no more promising. At length, towards the end of the season, the problem was solved. The East Rongbuk glacier leads to the north-east crest of the mountain. The climbers reached the head of the East Rongbuk glacier from the Kharta valley and ascended the north-east col of Mount Everest, the Chang La, to 23,000 ft., that is to say, practically 6,000 ft. from the summit. This point was reached at the end of September. Bad weather cut short the climb, and the attempt had to be abandoned, when at last the road to the summit seemed to have been found. This

[1] The writer of these notes makes no claim to any special knowledge of the subject or of mountaineering in general, but some experience of glacier travelling and low temperatures in Arctic and Antarctic regions enables him to appreciate the conditions encountered on Mount Everest and its approaches. Acknowledgments are made to despatches published in *The Times* and to various articles in the *Geographical Journal*.

is not the place to dwell on the scientific results, but they were important both in geology and biology, while a very considerable extent of new ground was surveyed.[1]

This year the Mount Everest expedition took the field with high hopes of success. Gen. the Hon. G. C. Bruce, who was in command, left Darjeeling with the main body at the end of March, some eight weeks earlier than the start of last year's expedition. Experience had proved that the end of May or the first half of June was the best period for the great climb. The expedition was on an elaborate scale. It consisted of twelve members, and required a great deal of transport, largely because of the oxygen apparatus and elaborate photographic equipment. Tibetan yaks, bullocks, mules, and donkeys, beside numerous hillmen, were employed. The early start entailed many difficulties; some of the animals were in poor condition, and the weather conditions as higher elevations were reached were anything but propitious. The expedition followed practically the same route through Tibet as the previous year, and eventually, at the end of April, all the party and its equipment were assembled at the base camp on the Rongbuk glacier at an elevation of 16,600 ft. The next step was to establish an advanced base on the north col at some 23,400 ft., provisioning it with stores and equipment, including a supply of oxygen, for work at high altitudes. Low temperatures and some trouble with Tibetan coolies caused unlooked-for delays, but a reconnaissance up the East Rongbuk glacier was successful in revealing a practicable route to the north col.

Camp I was established three miles south of the base camp at the mouth of the East Rongbuk glacier. It was provided with stone huts. From here a reconnoitring party set out on May 5 up the glacier, establishing Camp II at 19,360 ft. and Camp III on May 8 at 21,000 ft., under the towering cliffs of Changtse, the peak of 24,730 ft. which rises to the north of Mount Everest. This camp served as an advanced base to which the outfit was transferred as speedily as possible from the main base ten miles distant. No time was lost in looking for the route to the north col (Chang La). A reconnaissance party of Messrs. Mallory and Somervell established a camp (IV) just below the col on a convenient shelf. Several days later on, namely May 19, Messrs. Mallory, Morshead, Norton, and Somervell, with several porters, starting from Camp III, reached Camp IV and established Camp V at 25,000 ft. Two days later Messrs. Mallory, Norton, and Somervell climbed from Camp V to 26,800 ft. They found no considerable difficulties on the route, although the surface conditions were not good. No oxygen was used on this climb. Already the record in climbing altitude had been broken. The highest point previously reached by man was 24,583 ft., which was gained by the Duke of the Abruzzi on the Himalayan peak known as K_2 in July 1909. Mr. Mallory's party was only 2,200 ft. below the summit of Mount Everest, but at those altitudes even a short distance is a formidable task. They felt able to go higher when they decided to turn, but doubted their ability to get back if they continued. As it was, the descent to Camp III was painful and arduous: several of the party were frostbitten, and all suffered from the cold.

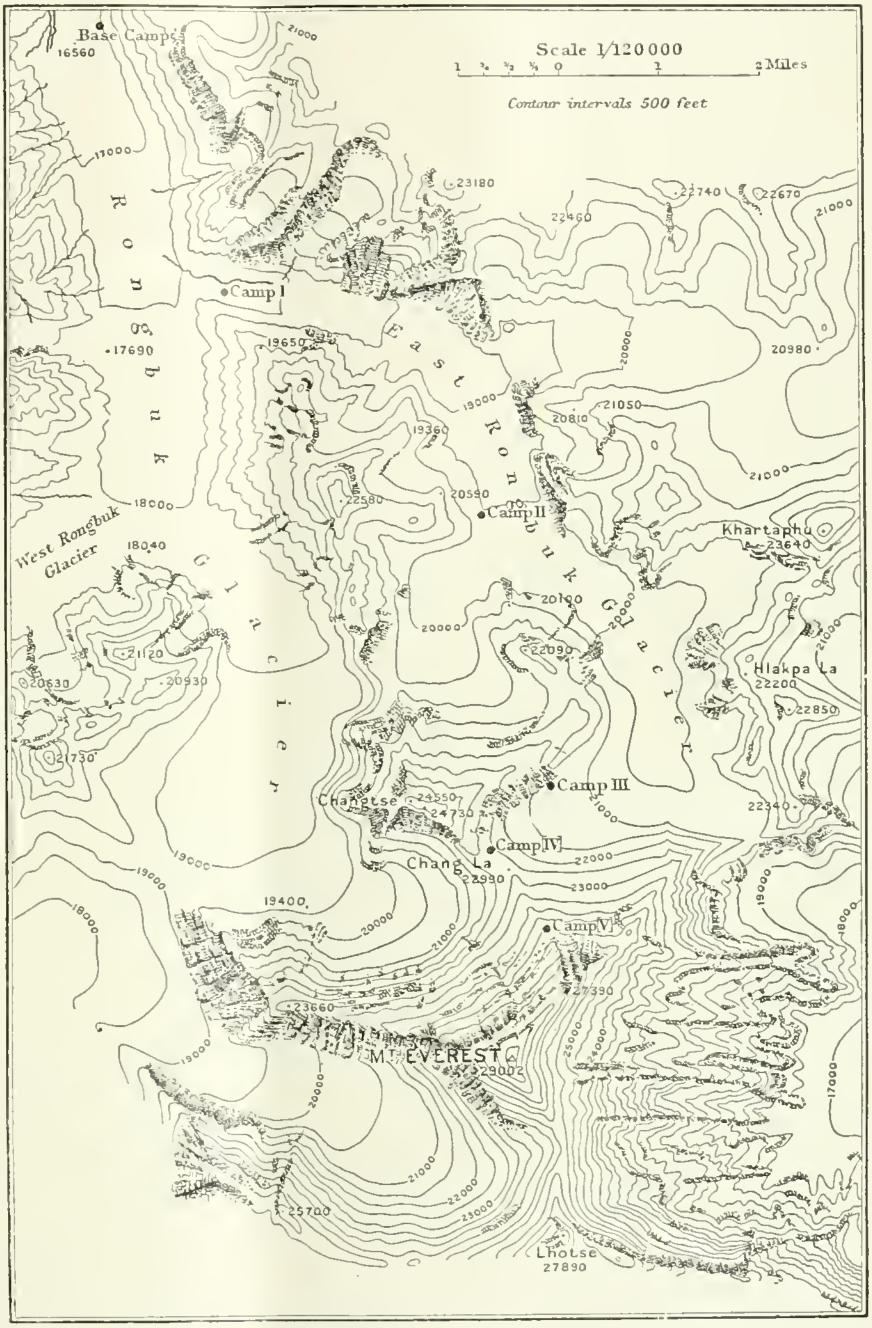
At the end of May another party, consisting of Messrs. Finch, G. Bruce, and a Gurkha, made a second attempt, and with the use of oxygen succeeded in reaching 27,300 ft. This climb was most arduous. At 25,500 ft. the party was stormbound for a night and a day. On the second night the climbers had a poor sleep, inhaling a quarter-ration of oxygen. At 26,000 ft. the Gurkha became exhausted and had to return. This allowed more oxygen for Messrs. Finch and G. Bruce, who continued alone, but it increased each load from 36 lb. to 48 lb. Within a few feet of the summit ridge which represents the last lap they were forced to turn back. A long detour entailing slow progress was necessary in order to reach the ridge, and for this they had no food supplies. An unforeseen disadvantage of the use of oxygen was found to be the hunger it induced, and in consequence the difficulty in carrying sufficient food. When the climbers returned the same day to Camp III, after a meal on the way at Camp IV, "we were finished: I doubt" (writes Mr. Finch) "if either of us could have taken another step." This climb fell short of the summit by 1,700 ft., but it was a magnificent achievement, and was to prove the culmination of the season's work.

By the beginning of June the prospects of success were still bright, for the monsoon was not expected to break for a week or two. Three of the climbers were out of action owing to severe frostbite or fatigue, but five were ready and apparently fit for another attempt. On June 3 a start was made from the base up the East Rongbuk glacier along the line of camps. Ill-luck dogged the party from the beginning. On the day of their departure the monsoon broke with a thirty-six hours' snowstorm. At Camp I Mr. Finch was forced to admit that he had not recovered from his last great effort, and fell out. Messrs. Mallory, Somervell, Wakefield, and Crawford continued, reaching Camp III on June 5. They rested for a day, enjoying superb weather, and set out for Chang La on June 6. The lower slopes of the col were in good condition with a firm snow surface, and the out-

[1] *Mount Everest: the Reconnaissance*, 1921. Lieut.-Col. Howard-Bury, D.S.O., and others. London, 1922.

look seemed promising. Messrs. Mallory, Somervell, Crawford, and one porter were leading, all roped. Farther down, on three ropes, there followed fourteen porters laden with food and the oxygen apparatus. The climbers were about half-way up the north col, at a relatively gentle slope, when suddenly the snow began to slip. The leading party was carried down about 150 ft. before the slide was checked. All four extricated themselves unhurt. But disaster had befallen the porters lower down, who were caught n the main slip. Two rope-loads had been swept over a 60-ft. ice cliff into a crevasse, on the edge of which the third rope-load had providentially stopped. There was little hope of any rescue, but two men were dug out alive and one was found unhurt, though dazed, on the surface. After some hours six bodies were recovered, but a seventh could not be found. This disaster ended the third and last attempt to reach the summit of Mount Everest. Gen. Bruce pays a high tribute to the capacity and cheerfulness of the porters. "It is terrible to think that no fewer than seven splendid porters lost their lives in this tragedy. . . . The work done by the porters was prodigious and unparalleled." The glacier camps were evacuated without further delay, and the whole expedition returned to India.

The effort which an attempt on the summit of Mount Everest demands is very formidable, far more formidable than the relatively brief telegraphic despatches in the Press have suggested. Yet it should be noted that Gen. Bruce and the other members of the expedition have expressed the belief that experience has given them greater hopes of succeeding than many of them had before. The work of climbing at high altitudes must be reserved for young men who must at the same time have knowledge of snow conditions. Experience has shown that nights can be passed at 25,500 ft. without oxygen, and an altitude of 26,800 ft. was reached without its use. This discovery was unexpected, since the experiments in a pressure chamber in England had indicated 23,000 ft. as the altitude above which oxygen would always be required. It was also found that even at great heights climbers who are deprived of the use of oxygen, whether by accident or exhaustion of supply, do not suffer any great harm. Mr. Finch, however,



MAP OF MOUNT EVEREST AND THE SURROUNDING DISTRICT.
Reproduced by kind permission of the Royal Geographical Society.

comments on a curious phenomenon in this respect. When he cut off his oxygen, at over 27,000 ft., he found himself suffering from a lack of decision. He hesitated in the choice of hand and foot holds in a strange way. On turning on the oxygen he became normal at once. Oxygen increases the climber's speed, but seems to result in greater exhaustion afterwards.

Fatigue is a serious obstacle. It is clear that a climber, however fit he may be, who exerts himself in gaining a great height is not likely to be of use for another great effort for some time. In view of the shortness of the climbing season, this means that there is no certainty that a climber can be relied on for two great efforts in one season's work.

The weather conditions seem to provide the greatest obstacle. The strong winds and the great cold are very trying. Even at Camp III, at 21,000 ft., the warmest night had a temperature only one degree above zero Fahrenheit: on one occasion a temperature of $-29°$ F. was recorded. This means the certainty of some casualties through frostbite. There are probably only some four or five weeks, just before the break of the monsoon, when the climb can be undertaken. For its successful accomplishment four consecutive fine days are necessary. Such conditions would appear to be very rare. This year's expedition never had more than two continuous days of fine weather.

The surface difficulties of the mountain did not prove greater than were anticipated, but the 1,700 ft. that remain to be covered appear to present some big obstacles. Mr. Finch wrote (*The Times*, July 18) as follows: "From the highest point reached on the mountain an excellent close-up view of the final ridge leading to the summit was obtained. The opinion was formed that though this final ridge is almost certainly climbable, it contains two severe obstacles in the nature of steep steps, the ascent of which entails not only difficult and steep rock climbing, but also very probably a considerable amount of step-cutting at altitudes above 28,000 ft."

We are glad to learn that, in spite of all difficulties, another attempt to reach the summit is to be made next year. It is to be hoped that this spirited adventure will be crowned with the success it merits.

DISEASE AND PERSONALITY

Encephalitis Lethargica, or Sleepy Sickness, has again been brought to the public notice by the appearance of the Ministry of Health's report on this subject. The striking drowsiness to which it owes its name is an example of how the nervous system reacts consistently to the disease attacking it. In one form a patient is emotional and cheerful; a patient with palsy is melancholic; while the general paralytic is overwhelmed with pride and self-importance. Some remarkable examples of this principle have been related by Dr. Head—cases in which, after the isolation by wound or disease of

[*Continued at foot of p.* 308.

The Antiquity of Man in America—II

By E. N. Fallaize, B.A.

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(*Continued from October No., p.* 268)

When we turn to South America, the question of the antiquity of man assumes a very different aspect. In North America, finds are few and scattered, and geological data are either absent, or meagre, or fail to carry conviction; in the southern half of the continent the geological evidence is at first sight more full, though also far from satisfactory; but finds attributed to early man in the form of skeletal remains, stone implements, pottery, and the like, have been brought to light, literally, in thousands. The distribution of these finds has also played a part in the elaboration of theory. With the exception of human remains, assigned by some to the Quaternary Age, from the cave of Lagoa Santa in the province of Minaes Geraes in Brazil, and some skulls from the Rio Negro, Patagonia, the evidence in question is all derived from Argentina and, for the most part, from the province of Buenos Aires, which has, therefore, been regarded as the place of origin of man in South America. The remains which constitute this evidence were found in the loess-like formation[1] known as Pampæan which overlies the crystalline rocks of the continental surface. The stratification of the loess indicates an alternation of aridity and humidity which corresponds in a general way with the variations in the extension of the ice cap in the northern part of the continent during the Ice Age. The Upper and Middle Pampæan are assigned to the Quaternary, the Lower to the Tertiary Age. It must, however, be said that there is a serious difference of opinion as to the relative chronology of some of the geological strata: some, which one school would assign to early Tertiary times, being regarded by others as "recent."

It would be impossible to deal here in any detail with these data. For nearly forty years they were studied by the late Señor F. Ameghino, who, as each fresh discovery was made, added to his theory of Early Man until he had elaborated a complete exposition of his line of descent and place of origin. It will be sufficient to mention here the principal finds upon which this theory was based.

[1] This loess formation is composed of aluminous clay, siliceous sand, and oxide of iron, the result of the process of denudation of the upper watersheds, gathered, brought down, and distributed by rivers. The muds thus deposited, when dried, have been subjected to prolonged wind-sifting and have become uniformly fine in texture.

Mention has already been made of the human remains from the cave of Lagoa Santa, found in the earlier part of the last century, which, on the strength of their association with the bones of extinct mammals, were assigned to the Quaternary period. Ameghino himself was the first to announce the discovery of fossil man of Quaternary age in Argentina at Arroyo de Frias in 1872 and 1874. Other finds made by Santiago Roth followed at Saladero and Fontezuelas. Another find of importance was the Arrecifes Skull, found by an employee of the Museo Nacional of Argentina and regarded as of Lower Quaternary age. Among remains of the Pampæan type from Ovejero, Ameghino found evidence for a dwarf race of not more than 1·30 metres (4 ft.) in height.

The first claim for the existence of Tertiary Man was put forward by Roth, who discovered the Baradero skeleton in 1887. Later investigation failed to substantiate the Tertiary date assigned to the strata in which it was found. Ameghino subsequently described a number of skeletal remains which he assigned to the Tertiary period. Of these, the more important are the Arroyo Siasgo skeleton, which, on the ground of certain morphological peculiarities of the cranium, he decided to be an extinct species to which he gave the name *Homo caputinclinatus* (or Head bent down), and the Arroyo del Moro find—still another species to which he gave the name *Homo sinemento* (or Chinless man). That which Ameghino claimed to be the most primitive of all, and to which he gave the name *Homo pampæus*, was the specimen, discovered in 1888, known as the La Tigra or Miramar Skull. Later, he identified other examples of *Homo pampæus*, notably some skulls and other remains found at Necochea.

Not only was the Ameghino convinced that he had discovered the absolutely primitive type of man, but he also held that he had found the precursor of man. A skull, or rather the fragment of a skull, found in the course of digging a dock at Buenos Aires he maintained belonged to a species of subhuman type, to which he gave the name of *Diprothomo platensis*, belonging to the earliest phase of the Pliocene Age (the fourth period of the Tertiary), while in an atlas [1] and femur (thigh-bone) which he argued came from the Upper Miocene —the third period of the Tertiary—he saw the remains of *Tetraprothomo argentinus*. Although no skeletal remains of an earlier date were found, he deduced the existence of earlier types from the evidence of burnt earth, which he maintained could not be due to natural causes, not only in the Oligocene, but also in the Eocene, the two earliest phases of the Tertiary period.

Upon this evidence Ameghino based a scheme of the descent of man which can most conveniently be exhibited as follows:

Subhuman precursors of man	*Tetraprothomo*	Precursor of Man four stages back.
	Triprothomo	,, ,, ,, three ,, ,,
	Diprothomo	,, ,, ,, two ,, ,,
	Prothomo	,, ,, ,, one ,, ,,
Earliest human types	*Homo.*	
	Homo pampæus.	
	Homo primigenius.	*Homo sapiens.*

From this the conclusion followed that man originated in America, and, owing to the number of finds in Argentina, Ameghino held that this was his place of origin.

It must not be imagined that these views were uncriticised. From time to time a majority of prominent anthropologists pointed out weaknesses in his arguments. In the case of the fragment of the skull of *Diprothomo*, it was shown that his failure to follow correct anthropological method in orienting [2] the skull had led to a complete misunderstanding of its character. An exhaustive examination of the evidence was made by Dr. Aleš Hrdlička and Dr. Bailey Willis, the geologist, of Washington, who visited a number of the sites of the discoveries and made a thorough examination of the terrain. Dr. Hrdlička also examined and measured all the human remains accessible to him. Dr. Willis's conclusion was that in no case was there any evidence for the geological antiquity of man. In some cases he was not convinced that the geological strata were anything more than "recent," while in other cases, where the strata belonged to the Quaternary or, possibly, the Tertiary epoch, there was every reason to believe that the skeletal remains had been deposited there by interment, or by intrusion through the agency of natural forces at a time subsequent to the original deposition of the strata. In many cases the geological evidence depended upon hearsay, or had been incorrectly recorded, or had not been recorded at all. Formations had been described as Tertiary or early Quaternary, which a more extended knowledge of geology would have shown to be recent. As was shown by subsequent analysis and experiment, the *tierra cocida*, or burnt earth, which was regarded as evidence for the

[1] The first cervical vertebra on which the head is balanced.

[2] Orientation is a technical term applied to the method of fixing a skull or fragment of a skull at a certain angle according to rule before any anthropometric observations are made. This ensures that measurements of different skulls are accurately comparable.

existence of man in Oligocene and Eocene times, required a far greater degree of heat for its production than could be attained by ordinary agency, and was probably due to volcanic action.

The results of Dr. Hrdlička's anthropological investigations entirely agreed with this view of the geological evidence, and in no case did he find that the skeletal remains were of a type differing markedly from that of the American Indian. Evidence upon which Ameghino had relied was due either to faulty methods, faulty observation, or faulty deduction. In a number of cases he pointed out that deformation of the skull, either posthumous or else artificial, such as was practised by the Aymara Indians, had been misunderstood by Ameghino and had led him to an entirely wrong conclusion as to the character of his specimens.

The masterly analysis of the evidence by these two eminent scientists, who were not merely impartial, but were, if anything, anxious to be convinced, has not been seriously questioned, and it may be regarded as conclusively settled that no greater antiquity can be claimed for man in the south of the American continent than in the north. Lest, however, it should be thought that the conclusions of Ameghino and those of his school were too lightly put forward, it may be pointed out that so distinguished a scientist as Dr. Bowman, the geologist of the Yale expedition to Peru, was convinced that he had discovered indubitable evidence which warranted him in attributing an antiquity of anything between 10,000 and 75,000 years to human skeletal remains discovered at Cuzco —a view which was only retracted after a careful re-examination of the evidence on the spot by Prof. Hiram Bingham.

Notwithstanding the unsatisfactory conclusion which inevitably results from a careful examination of the evidence adduced for the antiquity of man in America, it is not without profit that it should be reviewed. It serves as a warning that any fresh piece of evidence, which at first sight seems to warrant the attribution of a high antiquity to human remains found in America, must be received with extreme caution, and very carefully weighed before it can be accepted. In the case of the recently discovered tooth from the Upper Pliocene beds of Nebraska to which reference was made at the beginning of this note, where, so far as our information goes at present, the geological evidence is beyond dispute, its identification as a relic of a precursor of man will need most careful scrutiny and, as a matter of fact, it has already been called in question. It this connection, it must be remembered that no traces of the great ape type have hitherto been discovered in America—a fact which in itself must needs give rise to some hesitation before discarding previous conclusions as to the relatively modern appearance of the human stock on that continent.

(*Concluded*)

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Eclipses of the Sun

By H. Spencer Toy, B.Sc., A.Inst.P., F.R.A.S.

ECLIPSES of the sun may be divided into three classes partial, annular, and total.

In the first, the moon does not come directly between us and the sun, but passes a little on one side of the central line and so obscures only a part of the solar disc. In the second, the annular form, the moon is on the central line, but appears to be too small to hide the whole of the surface of the sun, so that even when it is projected entirely against it at the maximum phase, it is still surrounded by a ring of light. In the case of the total eclipse, however, the sun completely disappears behind the moon.

It is a curious and fortunate coincidence that the apparent sizes of the sun and moon are so nearly the same. The diameter of the sun is nearly four hundred times greater than that of our satellite, but its distance is also almost four hundred times greater, so that when looked at from the earth one body appears to be as large as the other. To these circumstances we owe our ability to see both the annular and the total form of eclipse, for as the sun and moon run through the small changes in their respective distances from the earth, so their apparent sizes vary somewhat and give one of them a slight preponderance over the other.

The geometrical conditions of an eclipse of the sun are shown in Fig. 1 (for clearness it is not drawn to scale), which shows the moon, M, between the earth and sun, S, throwing its shadow towards some part of the

earth and eclipsing the sun. The dark conical region is that within which the sun is entirely hidden from sight. This portion of the shadow is called the *umbra*. Around the umbra is an enveloping cone, shown shaded in Fig. 1, with its vertices directed towards the sun, the *penumbra*. To an observer within this region the sun is partly hidden from view. As the apparent path of the moon may pass from the north or south of the line joining the earth and sun, the axis of its shadow may pass from the north or south of the earth and may not meet it at all. An eclipse of the sun is called *central* when the shadow axis strikes any part of the earth; *partial* when only the penumbra falls upon the earth. It is evident that an eclipse can be seen as central only at those points of the earth's surface over which the axis of the shadow passes. An eclipse is total when the umbra actually reaches the earth; annular when it does not. These two cases are shown in Figs. 2 and 3. In Fig. 2 the shaded portion represents the shadow of the moon striking the earth; the sun is entirely hidden within the region *pp*. In Fig. 3 within the region *qq* it is seen that a part of the sun can be seen even when the moon is between it and the earth. In this case at the moment of greatest eclipse a narrow ring of sunlight is seen surrounding the dark body of the moon.

Eclipses fall naturally into groups or series, each of which Professor Turner calls a "family." The movements of the earth and moon with respect to each other and to the sun are such that after about eighteen years and ten and one-third days the three bodies come back almost to the same relative positions, so that after this interval an eclipse merely repeats itself, and continues to do so every succeeding eighteen years. Any distinguishing feature of one eclipse, as, for instance, an unusually long duration, recurs in all the rest, and so is a characteristic of the whole family. This period was known to the ancients and called by them the Saros.

The eighteen years and ten days that constitute the Saros imply that the period contains five leap years. If it contains only four, then the extra odd days will, of course, be eleven, and if the period includes only three leap years—as, for example, from 1897 to 1915 (1900 was not a leap year)—then the odd days will be twelve. This point is not always stated clearly, with the result that there is not a little popular confusion about the additional days.

The different families are distinguished on maps by the tracks they trace out on the earth. In order to be definite in speaking of the tracks, we will confine our attention to the eclipses in which totality occurs. The track of one eclipse does not fall on the same part of the earth as did the previous one, for the odd fraction, viz. one-third, of a day in the Saros causes it to shift one-third of the way round the globe. It follows, therefore, that the fourth of such tracks will have shifted three-thirds, or the whole, way round. Similarly, the seventh will have gone round twice, so that the first, fourth, seventh, etc., will all lie in the same part of the earth, the interval between them being a little more than fifty-four years. But although these lie in the same part of the earth, yet it is found that the fourth does not cover precisely the same line as the first; it has moved a little to the north or south, as the case may be. The seventh has moved a little farther still, and so they go on until one of the Poles is reached. When this happens, the family leaves the earth entirely and so becomes extinct.

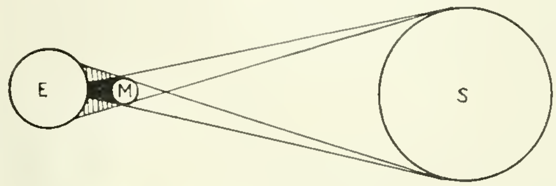

FIG. 1.

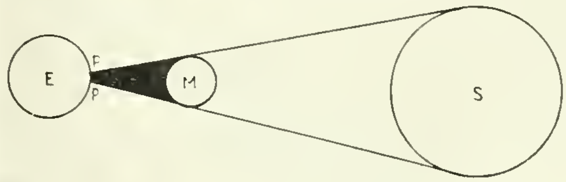

FIG. 2.

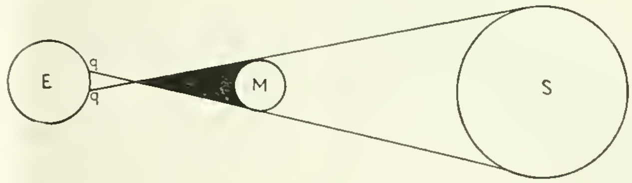

FIG. 3.

The life-history of a family extends over something like 1,260 years. The first member comes into existence when its penumbra first grazes the earth not far from one of the Poles. Then there follow a dozen partial eclipses, each larger than its predecessor. By this time the central line has come in at the Pole and we have a series of forty or fifty total or annular eclipses. About eighteen of them will be total and twenty-seven annular, the ratio of total to annular being approximately two to three. In the middle of the series the central line strikes the earth near the equator; it continues to progress in the direction in which it has already been travelling, and leaves the earth near the Pole opposite to that near which it entered. Then come another dozen partial eclipses, and the family becomes extinct. (It must be stated that the numbers given in this paragraph are only approximate.)

Chambers traces one such family. It began at the

North Pole in June 1295. On August 27, 1367, it made its first appearance in the north of Europe; in 1439 it was visible all over Europe; in 1601, its eighteenth appearance, it was central and annular in England. It appeared again in June 1908, and will return in July 1926. At its thirty-ninth appearance, the shadow track will have passed the Equator. The family continues to travel south, and finally it will disappear in 2665.

There are twelve families of total eclipse tracks in existence at any one time. Six of them are moving north, and six moving south. When one family goes out at one Pole another comes in at the other, and thus their number is kept constant.

The next new family will come in at the South Pole on May 29, 1938. The series of particular importance to Britishers, however, is that which contains

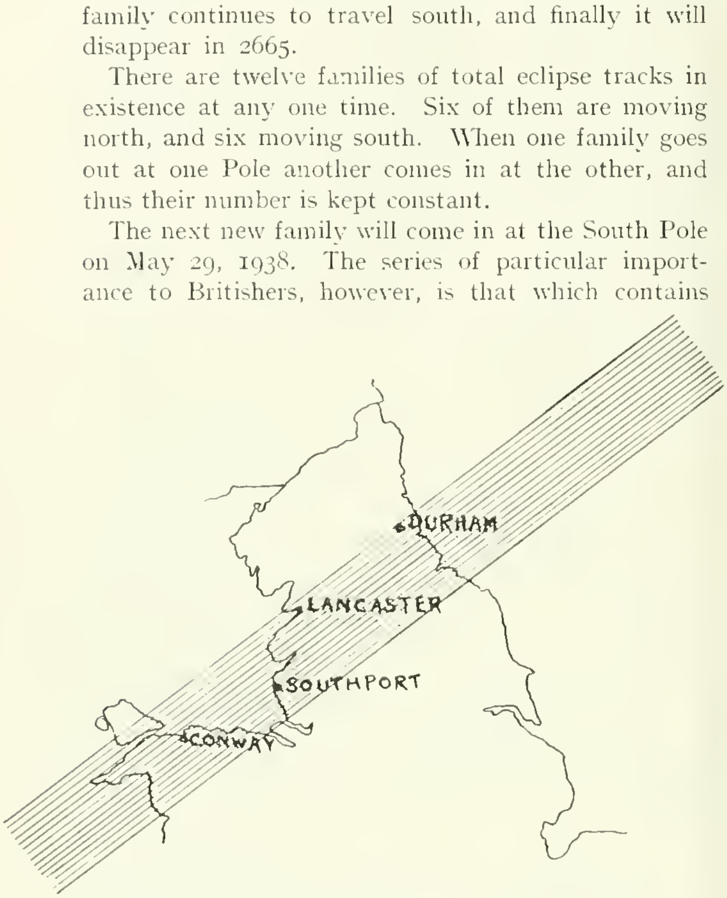

FIG. 4.—PATH OF TOTAL ECLIPSE OF 1927, JUNE 29.

the eclipse of 1927, for in that year the track will cross the north of England. The eclipse will take place on June 29, and will be total along a band including Conway, Liverpool, Southport, Lancaster, Ripon, and Durham, the central line running from St. David's Head to a point between Whitby and Hartlepool. It will be the first one visible as such in the British Isles since May 22, 1724, an interval of more than two hundred years.

The path just described will be traced out in the morning; so will be the beginning of the track, which will pass on to Scandinavia and Northern Asia. At its fourth subsequent return, that of 1981, the beginning will be displaced sufficiently to miss the British Isles, but at the following return, on August 11, 1999, the middle section of the track will just graze the extreme west of Cornwall.

Since there are only twelve families of total eclipses, and each recurs but once in eighteen years, it follows that a total eclipse cannot take place annually. The way in which eclipses do actually occur will be seen from the following list, which covers the eighteen years, and so includes one member of each family. The maximum duration of each is given.

Date.	Duration.	Where Visible.
	mins.	
1922 Sept. 21	6·1	East Africa, Australia.
1923 Sept. 10	3·6	California, Mexico, Central America.
1925 Jan. 24	2·4	United States.
1926 Jan. 14	4·2	East Africa to Philippines.
1927 June 29	0·7	England, Scandinavia.
1929 May 9	5·1	Sumatra, Philippines.
1930 Oct. 21	1·9	Pacific Ocean, Patagonia.
1932 Aug. 31	1·5	Canada, East United States.
1934 Feb. 14	2·7	Borneo, Celebes.
1936 June 19	2·5	Greece to Central Asia.
1937 June 8	7·1	Pacific Ocean to Peru.
1938 May 29	4·0	South Pole (already referred to; new family).
1940 Oct. 1	5·7	Colombia, Brazil, South Africa.

The approximate date of the next member of any family may be obtained by adding eighteen years.

The series which includes 1937 is remarkable for the long duration of total eclipse. Those of 1937 and 1955 will fall not more than 20 secs. short of the absolute maximum of 7 mins. 30 secs. But the 1934 series will increase to even greater duration, reaching in 2150, June 25, a length of about 7 mins. 16 secs., and in 2168, July 5, a length of 7 mins. 28 secs., the longest hitherto known in historical times. The former will pass over the Pacific Ocean, the second over the southern part of India near Madras.

It will be noticed that both these eclipses occur near midsummer. As a general rule, a summer eclipse is likely to be of longer duration than one which takes place in the winter, for in the summer the earth is at its maximum distance from the sun, so that the latter appears to be of minimum size, and can therefore be concealed by the moon for the greater time.

The Saros is, of course, the most important period of eclipse recurrence, and is the governing factor of the "families." There is, however, another important period. This contains 10,571·95 days, about 20·3 days less than twenty-nine years. But in this period the eclipse may vary from total to annular. Thus the annular eclipse of February 14, 1915, will be followed by a total eclipse on January 25, 1944; that total on April 16, 1893, was followed by the recent annular on March 27, 1922; but the total eclipse of May 28, 1900, will be succeeded by a total eclipse again on May 9, 1929.

It might sometimes happen that even the same

eclipse would be both annular and total, the former in one part of its track, the latter in another. This is a very rare phenomenon, and is due to a slight variation in the moon's distance from the earth during the progress of the eclipse, the earth being all the time close to the apex of the lunar shadow. Or if the earth were actually at the apex, the shadow would just exactly reach it, with the result that a total eclipse would be observed at the moment when a perpendicular upward view could be obtained, but this would be preceded and followed by some minutes of the annular phase. One such eclipse took place on December 12, 1890 (see Fig. 5).

An interesting series in the twenty-nine-year period is that containing the historical eclipse of Nineveh, which was visible in the year 763 B.C. on June 15. This is recorded in the Assyrian tablets. Adding the period we are considering, we find other eclipses on May 27, 734 B.C., May 7, 705 B.C., a series continuing

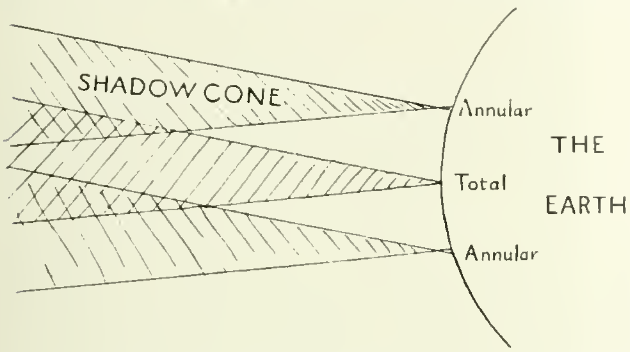

FIG. 5.—SHOWING THREE POSITIONS OF THE SHADOW-CONE.

to our own times in the eclipses of 1814, July 17 (total); 1843, June 27 (annular); 1872, June 6 (annular); 1901, May 18 (total); the last-mentioned being the ninety-third of the series since that of Nineveh. Between each of these eclipses the lunar perigee—that point in the moon's orbit at which it is nearest to the earth—moves through about 242·4 degrees, so that after three such intervals it has advanced through 727 degrees, and, since 720 degrees is twice round the circle, it is thus only 7 degrees in advance of its original position. For a long period of, say, a thousand years or more, every third eclipse of the series—i.e. every one recurring at 3×29, i.e. 87 years—will therefore be of the same character. Thus those of 1814, 1901, 1988, in the above series are total.

The dates mentioned above involve a change from the so-called Old Style to the New. The latter was introduced in 1582, and the formula for conversion from one to the other can be set out in a word or two. To get the New Style from the Old, if the year under consideration comes anywhere—

From 1582 to 1699 add 10 days.
,, 1700 ,, 1799 ,, 11 ,,
From 1800 to 1899 add 12 days
,, 1900 ,, 2099 ,, 13 ,,

Similarly, to change from the New Style to the Old, the days must be subtracted.

If a longer view be taken of this twenty-nine-year period, it will be noticed that when it is multiplied by eighteen, the few days short of twenty-nine years amount to practically a whole year, the result being that eighteen times the period is almost exactly 521 years. The consequence of this is that after this lapse of time the eclipses recur on the same day of the year. Thus if we take the Nineveh eclipse of 763 and add 521 a number of times, we get the years 242 B.C., 280, 801, 1322, and 1843 A.D. In each of these years, therefore, the eclipse took place on June 15, Old Style, or, using the above formula for 1843, on June 27 in that year, a result agreeing with that already given.

Reference has been made earlier in this article to the eclipse of 1927, June 29, the first to be total in Britain for more than 200 years. If we subtract twice 521 years, i.e. 1,042 years, and convert from New to Old Style we find that its predecessor occurred in 885, June 16. This was total in Scotland, its track being shown by Maguire in the *Monthly Notices* of the Royal Astronomical Society (vol. xlv) to run from S.W. to N.E., thus being practically parallel to that of 1927.

Since total eclipses are not very frequent, and when they do occur are seen as such only from a narrow strip on the earth, it will be realised at once that they are very uncommon in any locality, especially in any particular town. Six only have touched any part of the British Isles for the last five hundred years, the dates being:

1424	June 26	1652	April 8
1433	June 17	1715	May 2
1598	Mar. 6	1724	May 22

If we extend this list backwards for another thousand years, we find eleven more total eclipses visible in the British Isles:

594	July 23	1023	Jan. 24
603	Aug. 12	1133	Aug. 1 (C)
639	Sept. 3	1140	Mar. 20 (C)
664	May 1 (C)	1185	May 1 (C)
878	Oct. 29 (C)	1330	July 16
885	June 15		

"C" indicates a reference in the Anglo-Saxon Chronicles. The eclipses have included London twice, Dublin twice, and Edinburgh five times. Of the seventeen in the list, that of 885 was of the longest duration, lasting in England for 4 mins. 55 secs.,

whilst that of 1330 was the shortest, lasting 4 secs. short of a minute.

An interesting point in connection with eclipses, both lunar and solar, is the times at which they occur in any particular year. These are grouped into two chief divisions, separated by about six months, and known as the "Eclipse Seasons." Eclipses can occur only when the sun is near a node,[1] and this happens only twice in the year. Hence we have the general rule that in any year there are two dominant eclipses separated by about six months, whilst others may occur a fortnight before or a fortnight after them.

This might seem to imply that the eclipse seasons are in the same months year by year, an implication contrary to experience. The nodes are continually changing their positions, with the effect that the eclipse seasons come about eighteen or twenty days earlier in succeeding years. This can be seen if we tabulate the eclipses for a year or two.

FIG. 6.—TOTAL ECLIPSE OF 1914, SHOWING CORONA.
Reproduced, by permission, from the "Monthly Notices" of the Royal Astronomical Society.

Year.	Date.		Mean.
1921	April 8	Sun	April 15
	April 22	Moon	
	Oct. 1	Sun	Oct. 8
	Oct. 16	Moon	
1922	Mar. 28	Sun	
	Sept. 20	Sun	
1923	Mar. 3	Moon	Mar. 10
	Mar. 17	Sun	
	Aug. 26	Moon	Sept. 3
	Sept. 10	Sun	

The maximum number of eclipses that can occur near any one mean date is three; there cannot normally be more than six in a year, a number not often reached. Occasionally, however, there may be seven, but only if the eclipse seasons come either in January and July, when there may be overlapping from the succeeding year, or in June and December, when there may just come in an extra one from the previous year.

This greatest possible number, seven, was reached in 1917, and will be reached again in 1935. It was reached once in the nineteenth century. According to civil time, 1805 had seven, but as the first occurred at 1 a.m. on January 1, it would count as in 1804 according to astronomical reckoning, in which the day is regarded as beginning at noon. But as against this, 1823 had six according to the civil reckoning, and seven according to the astronomical, the last occurring at 8 o'clock on the morning of New Year's Day 1824, a time astronomers would call 20 o'clock on December 31, 1823. We may, therefore, count either 1805 or 1823 as having had seven eclipses, according to the system we adopt, but we cannot fairly count both.

It may be mentioned in passing that this dual system of reckoning is to terminate at the end of 1924. The astronomical New Year's Day of 1925 will commence at midnight, and thus conform to civil time.

There seems to be no period of years which will bring round the recurrence of seven eclipses with certainty. There is a tendency to 112, as, for example, from 1805 to 1917. Adding another 112 years we have 2029, which misses the seven only by a few hours. Then, of course, the Saros might sometimes apply, as from 1917 to 1935, but we cannot state this with accuracy as being generally true.

The eclipse season also determines the direction of the path of the total eclipse upon the earth. In March it runs from S.W. to N.E., and in September from N.W. to S.E. In June the track is a curve, running first to the N.E. and then bending round to S.E., and in December it runs S.E. first and bends round to the N.E. In intermediate months we have a compromise between these extremes.

[1] The "nodes" are the points in which the orbit of the moon cuts the plane of the ecliptic, or the orbit of the earth.

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In 1887 Oppolzer published at Vienna his monumental work entitled *Canon der Finsternisse* (Canon of Eclipses), which contains the approximate elements of all eclipses (8,000 solar and 5,200 lunar) between 1207 B.C. and A.D. 2162, with charts for all annular and total eclipses of the sun.

In vol. xlv of the *Monthly Notices of the Royal Astronomical Society*, Maguire has an article on the total eclipses in the British Isles, together with a map.

Most textbooks on astronomy contain much information on this subject, the article on "Eclipses" in the *Encyclopædia Britannica* being particularly good.

An excellent popular account is given in Professor H. H. Turner's *A Voyage in Space* (S.P.C.K. 6s.).

The British Association's Meeting[1]

The meeting at Hull this year was useful rather than distinguished. A mass of important subjects was described and discussed, some of which are of interest to many besides specialists. The presidential address by Sir Charles Sherrington, however, dealt with a subject that is difficult to describe to the layman, problems of the mechanism of vital processes, especially those of the nervous system, and can be followed in detail by physiologists only. There is a considerable number of amateur scientists who bother publishers with their immature manuscripts on such problems as the origin of life, the relation of mind to matter, and kindred subjects, described or touched on in the presidential address; it is good to know that, if they give the address the attention which it deserves, they will remain quiescent for a time and be the wiser at the finish. The philosopher, too, not yet recovered from the fatigue of absorbing the theory of Einstein (which, fortunately, by the way, was given a rest this year), has now got a further problem to engage his attention. And physiologists themselves are divided with respect to a conclusion on which the president laid great insistence, namely, that biology must in ultimate analysis be nothing but physics and chemistry. The address, therefore, has the merit of stimulating discussion among those who can understand it. It is this setting men thinking and talking on a really important problem, that is only partly solved, which helps so much towards a complete or at least a provisional solution of it. Some notes are given below of a few of the subjects discussed. Several of the topics, like those on agriculture or on economics, do not come within our range. Others, like those on the migration of the eel, the fixation of atmospheric nitrogen, Wegener's theory of the origin of the continents, and the atoms of matter, have been discussed in articles in earlier issues of this journal.

MENTAL CHARACTERISTICS AND RACE

This subject was discussed at a joint meeting of the Anthropology and Psychology Sections. Professor J. L. Myres said that mental qualities were inherited just as physical characters were, and therefore it might be assumed they stood in some direct relation with some element in the nervous system. Some mental qualities appeared to be associated with physical characteristics, for instance, fiery temper and red hair. The novelist had long made use of such associations, and everybody knew what was expected of a hero with steel-blue eyes or a horse-face. Professor Myres described how it was possible to some extent to enhance and combine mental qualities in certain domestic animals. In illustration he spoke of the recent establishment of the Rhodesian lion-hound, which was bred with strength and courage to attack, great speed, and tenacity to hold on. Individuals did not always exhibit, however, the characteristics expected of them. There were gun-shy pointers, for example, and even gun-shy men in military families.

Dr. C. S. Myers said that the two chief influences on mental character were heredity and environment. Sunshine, humidity, earthquakes, food-supply—all these had an important influence on the mental character of a race. Physical appearances were sometimes misleading. There might be handsome boys and girls in a family of deficients. The explanation of that was that they had been given a false start, which had interfered with the growth of their minds, but not with their bodies. An accident in infancy might interfere with development and make a man, who would otherwise have been brave, gun-shy. It was interesting to see how different countries were developing different human types. It was now possible, for instance, to distinguish the New Zealander from the Australian. How these types came about was not known, nor was it known how long they might persist. Even different parts of a country showed marked characteristics. In our own country Yorkshire and Welsh people were musical. Another interesting fact was that a characteristic might appear for a time and then disappear. England in Elizabeth's day was pre-eminent in music; at various times other countries had been pre-eminent in different branches of art.

Mr. E. N. Fallaize quoted from two writers in the time of King Henry VIII to show how little had been the change in national characteristics. The first writer, a Scot, described the Frenchman as volatile, the German as wily, and the Englishman as full of pride and with a great deal of self-satisfaction. The second, the Venetian Ambassador in London, described the English as hospitable and generous, and said that if an English working-man met in the street a friend who was starving he would not give him a slice of bread, but would say, "Come and have a drink."

THE AGE AND AREA THEORY

One of the chief subjects discussed at a joint meeting of the Zoology and Botany Sections was a statistical theory of the geographical distribution of plants and animals recently published by Dr. J. C. Willis in a book entitled *Age and Area*. Dr. Willis, in opening, said that Darwin's great contribution to science was the establishment of evolution as the

[1] *The Advancement of Science*: 1922 (John Murray, 6s.). *Nature*, September 9 and 16. Reports in *The Times*, September 9–14.

mode in which animals and plants had come into existence, but he held that his special theory of natural selection was now disproved and worthless. For some reason the plant has advantages which enable it to spread. His theory explained the present distribution of plants and animals on a mechanical principle so well that it could be applied successfully to predicting unknown cases. His reason for it was that he found that the area occupied by species varied with their age, new species occupying very small areas, and older species having a wider distribution. Moreover, older genera had a larger number of species than younger genera. The theory explained evolution and the spread of animals and plants as strictly mechanical processes depending in no way on natural selection.

This new theory was opposed by several important speakers, who pointed out that the actual facts of the distribution of plants did not agree with those predicted by the theory. The general opinion was that no problem in biology could be determined by statistics, for these were merely "smoothed abstractions of actual facts." Observation and experiment were the avenues to understand living things, and the more patiently these were pursued in the spirit of Darwin, the more they appeared to confirm the main lines of his work.

CRITICISM OF M. COUÉ'S METHOD

A second piece of work that was adversely criticised was the Coué method, which has recently created great stir in the land. Dr. W. Brown dealt with it incidentally in a paper to the Psychology Section on auto-suggestion. M. Coué has an extraordinarily clear and penetrating insight into the facts of suggestion, transparent sincerity, and untiring zeal. But he is not a doctor, so that in a sense he is an amateur. And medical men specialising in neurology and psychotherapy have employed similar methods of treatment on suitable patients with success in no way inferior to that claimed for his work. Their more profound knowledge of the facts of physical and mental disease has allowed them to make progress in psycho-therapy which leaves the amateur far behind. Auto-suggestion, or the patient's appeal to his own subconscious mind, must always be supplemented—and sometimes so extensively as to be replaced—by knowledge of many of the chief motive-forces actuating that subconscious. Dr. Brown said it was quite unnecessary to repeat a parrot-phrase twenty times. (A later speaker said that such repetition in curing a headache had brought on sore throat!) He also gave an account of his own methods of treatment by suggestion and auto-suggestion (which are described in his recent book *Suggestion and Mental Analysis*), and told how children, who could not concentrate their minds, responded to it. For example, a little girl of thirteen, who was very bad at writing essays, was treated by him, and after eight hours' treatment was able to do her essay-writing properly and well.

PROBLEMS IN THE THEORY OF NUMBER

The presidential address to Section A (Mathematics and Physics) was given this year by Mr. G. H. Hardy, the Professor of Mathematics at Oxford. He propounded five problems in the theory of numbers which are yet to be solved, three of which are of general interest. The first is: *When is a number the sum of two cubes, and in how many ways may it be so expressed?* The numbers 2 and 9 are sums of two cubes, the former being equal to $1^3 + 1^3$, the latter to $2^3 + 1^3$; 3 and 4 are not. It is exceptional for a number to be the sum of two cubes, and such numbers become rarer and rarer as investigation extends to larger and larger numbers. No simple test has yet been discovered by which such numbers can be distinguished. Again, 2 and 9 are sums of two cubes and can be expressed in one way only, but there are numbers so expressible in a variety of ways. 1729 may be expressed in two ways, $12^3 + 1^3$ or $10^3 + 9^3$, and is the smallest number to be expressed in this way. This has been worked out mentally, but, when a number is sought which is the sum of two cubes expressible in three ways, the computer requires paper. The smallest number indeed is 175,959,000, which is $560^3 + 70^3$ or $552^3 + 198^3$ or $525^3 + 315^3$. There is one number known which may be expressible in four ways, 912,646,702,079,469,000, a number so huge that when we are told that no one has discovered a number which may be represented in more than four ways we do not feel altogether surprised. Theory, however, has run ahead of computation and has shown that numbers exist which may be expressed in five, six, or in any number of ways.

The second problem is also a difficult one: *Is every large number the sum of five cubes only?* It is known that every number without exception is the sum of nine cubes and two numbers, 23 (which is $2^3 + 2^3 + 1^3 + 1^3 + 1^3 + 1^3 + 1^3 + 1^3 + 1^3$) and 239 ($5^3 + 3^3 + 3^3 + 3^3 + 2^3 + 2^3 + 2^3 + 2^3 + 1^3$), cannot be expressed as a sum of less than nine. There are only fifteen, the largest being 454, which need eight, and one hundred and twenty-one, the largest being 8,042, which need seven. Numbers expressible as the sum of six cubes are probably all less than 1,000,000. Beyond this all numbers may probably be expressed as the sum of five, or, with very large numbers, of four, but the numbers are so large that computation is helpless. Numbers expressed as the sum of four

persist for ever, since there are certain forms of numbers which cannot be expressed in less.

The third problem is: *Is* $2^{137} - 1$ *a prime number*, that is to say a number without factors other than unity and itself? Part of the interest of this still unsolved problem lies in the fact that a certain mathematician, Mersenne, asserted in 1644 that the only values of the index n up to the number 257 for which $2^n - 1$ is prime are 2, 3, 5, 7, 13, 17, 19, 31, 67, 127, and 257. This assertion was believed to be true for many years, because there was no evidence to the contrary, and mathematicians wondered how Mersenne had arrived at this result. Had he discovered some formula which he kept to himself, and which later mathematicians had failed to rediscover? It was believed so, and an enormous amount of labour and of paper was expended in trying to verify this assertion. It has now been established that part of it is probably mere guesswork based on inadequate evidence and is wrong. 67 should have been left out; 61, 89, and 107 included. Mersenne may also have been wrong in omitting 137. It is now the least value of n, for which the answer is still in doubt. When written out $2^{137} - 1$ is a number of forty-two digits, so a computer setting out to verify if it be a prime number has a considerable task before him!

THE ORIGIN OF COAL SEAMS

The purport of Professor Kendall's presidential address to the Geology Section was to show that coal seams are the result of growth and accumulation of peat, on the spot, and that all the phenomena of the British coal measures can be explained upon this hypothesis. True, coal seams are characterised by certain definite facts. They are of wide extent, show uniformity of thickness and character over extensive areas, are very free from admixture with the accumulated matter resulting from the disintegration of rocks, and show no signs of aquatic animals within the seam. The inference is that in the main they are formed from old beds of peat in a lowland area which has undergone, in the course of geological time, intermittent depression such as would bring in at one time the muds and sands from flowing water and at another time even the sea. It is of interest to note that near at hand there is at the present day an area which corresponds closely to the areas in past ages from which the coal measures have been formed. This is the North Sea. At some period subsequent to the last ice age the whole of the British Isles appears to have stood relatively to the sea about 80 ft. above its present level. The North Sea was then a vast plain, so nearly at the sea level that it became a morass. Round its margins were forests of oak, pine, and birch, and the greater part of the area furnished the conditions for a great peat swamp. At the present day it is a huge bed of peat, throughout its length and breadth, as trawlers testify, and at its edges on the coasts of Holland and of England, as observations at favourable conditions of the tide show.

BREATHING AT HIGH ALTITUDES

Mr. J. Barcroft, F.R.S., an authority on respiration, and the leader of an expedition which has recently been out to the Andes to study the effect of the lack of oxygen on the human system, gave an account of his observations to the Physiological Section. His party made their observations in a mining village in Peru, 14,200 ft. above sea-level. At that altitude they were slightly out of breath, even when sitting down, and exertion like walking up hill made them pant. They found their brains worked much more slowly than at lower altitudes. The people who lived at these extreme altitudes, and consequently were acclimatised, were very short of stature, but had the chests of men of 5 ft. 11 in. Cows, they found, could give milk when living at 12,000 ft., but not at 13,000 ft. At 14,000 ft. they gradually died of lack of oxygen. At this elevation dogs, ponies, and sheep could live, but dogs not very happily. These experiments, like those conducted at other places of high elevation, such as in Tibet and on Pike's Peak, are throwing a flood of light on the subject of respiration which is of great practical interest to all those who venture to high elevations, whether on the ground or in the air.

A. S. Russell.

Reviews of Books

COUNTRIES AND CLIMATES

The Climate of the Continents. By W. G. Kendrew, M.A. (Oxford: Clarendon Press, 21*s*.)

Mr. Kendrew differs from most of us in speaking and writing of the weather in no mean or narrow sense. We are dwellers in small places; Mr. Kendrew is a citizen of the terrestrial sphere. Our interest in climate is mainly personal, confined to the present or recent past, and to our immediate neighbourhood, and useful as an opening in polite conversation; Mr. Kendrew's is deep and abiding, not confined to country-side or country, but content with embracing nothing less important than what O. Henry called the terrestrial, globular, planetary hunk of matter, slightly flattened at the poles, known as the Earth.

Yet the subject is, or can be made, very interesting, because it touches us at many points, and its study need not prostrate us. We cannot always understand the

weather, but we can understand what is meant by it; we recognise its phenomena. No scientific subject needs less of the jargon or the conventions of science in being expounded than this one. Its effects come within either the experience or the imagination of us all; we can imagine an earthquake or a tornado or even a mosquito bite, and we are able to follow without further explanation that 105° in the shade of a moist country is quite definitely warm. But besides interest the weather possesses the gift of permanence. It changes with the seasons, but the seasons do not change, or at least they change little in the life-time of man. How few things accurately described a hundred years ago could be described in nearly identical terms to-day! Climate is one of the few.

It might be thought that a subject of such interest and such permanence must often have been described in books, but no. Mr. Kendrew's is the first description in English of the actual climate of the countries of the earth considered regionally. There are a few books in English which describe the climate of parts of the earth, and there are all-embracing tomes in German, but till now English geographers have hesitated in making a comprehensive compilation.

A work of this kind must be essentially a composition from such materials as statistics, more or less adequate, maps showing certain factors of climate, and regional descriptions; and the result must be largely dependent on the nature of the original sources. But Mr. Kendrew has done his work well. He has now given to the public an informed and interesting general account of the climate of the continents which may constitute a framework into which detailed local descriptions may be intelligently fitted. Behold, then, the author taking the great round world in his hand, so to speak, and beginning with Africa, gradually working round the globe; telling us of each country in turn, its changes of temperature, its rainfall, its prevailing winds, and all the things embraced by climate; illustrating his forty-eight chapters with a hundred and fifty illustrations; including many tables of statistics, and quoting at times many vivid descriptions of travellers of the weather at different parts of the earth. It is impossible not to be interested in his book.

We will quote first of all a description by Borius, included in the book, of a day in a very unpleasant climate, Senegambia, in the rainy season:

"Soon after sunrise the shade temperature is 80°. The calm air gets hotter and hotter, and by 9 a.m. it is unpleasant to walk about even with a sunshade. . . . At midday the thermometer is still rising, and by 1 p.m. it stands at 86°. . . . By 4 p.m. the temperature is 88°; the sky is three-fourths clouded, and masses of cloud are piling up on the horizon; the wind often drops altogether. The heat now feels excessive, and though after 4 p.m. the thermometer hardly rises a degree, yet the heat seems to be increasing considerably, and we are astonished that the thermometer does not show a greater rise. We perspire profusely on the slightest exertion. . . . We go in again, but the heat indoors is overwhelming and we long desperately for a breeze. There is no need for a hygrometer to show that the air is saturated with moisture. It is this high humidity that makes the heat so overpowering, although the actual temperature is not excessive.

"Nothing can be compared with the feeling of utter prostration that overcomes a European. Though he sits motionless in an arm-chair he perspires as after violent toil; his fatigue is not like what is felt after work, but rather a weakness in the limbs, and especially in the bones—an indescribable feeling of discomfort, which precludes all movement, all bodily or mental work, but yet forbids sleep. Clouds of mosquitoes swarm round him and he feels suffocated.

"At 10 p.m. it has fallen dead calm. The temperature still continues high and our discomfort becomes more depressing than ever. We can neither read nor work, to do so would require an effort of will which we are incapable of making; our mental energy is sapped even more than our physical strength. Night drags on in this painful way unless a thunder-storm falls and we feel a salutary freshness in the air. . . ."

Another unpleasant place is the Punjab in the summer.

"A denizen of the temperate zone can hardly realise the desiccating, truly scorching heat of the wind. When exposed to it, one may imagine he is facing an open furnace. The thermometer rises in the shade to over 120°. . . . After 7 a.m., save of necessity, no European leaves his house, and should business oblige him to do so, he must protect himself from the sun with a sunshade and a thick head-covering. . . . At sunrise, or soon after 5 a.m., houses must be closed, only a small door being left open for communication with the outside world. So long as the hot winds blow strongly and steadily, rooms may still be kept in some measure cool by means of "tatties" or grass screens set up in front of the doorway, and continually sprinkled with water, or by the fan vanes of the so-called 'thermantidote,' which a servant keeps revolving and sprinkles with water; and at night the punkah is worked. Whoever cannot provide himself with these artificial appliances must suffer the daily torment of insupportable and exhausting heat. Man and beast languish and gasp for air, while even in the house the thermometer stands day and night between 95° and 115°. Little by little the European loses appetite and sleep; all power and energy forsake him. Vegetation suffers equally; almost all green things wither; the grass seems burnt up to the roots; bushes and trees seem moribund; the earth is as hard as a paved highway; the ground is seamed with cracks; and the whole landscape wears an aspect of barrenness and sadness. At length, in June, the hot winds cease to blow, and are followed by a calm; and now indeed the heat is truly fearful; grass screens and thermantidotes avail naught; all things pine for the rains; but no rain, not even a shower, can we hope for, till the south and east winds shall have set in."

Senegambia and the Punjab, then, are undesirable places for Europeans; so too is Cherrapunji near the Bay of Bengal. This is the wettest place in the world, its

annual rainfall exceeding the west side of Kamerun peak, which is next wettest, by 46 inches. It is really wet at Cherrapunji. Its mean annual rainfall is 458 inches, and in one year 905 inches actually fell! 41 inches, twice as much as the mean rainfall for the whole year in the east of England, has fallen in a single day.

Where is the best climate to be found? This question is not specially discussed by Mr. Kendrew, but from his material and from known preferences one may arrive at a provisional answer. Of course by "best climate" one usually means the best place to live in, and that depends on several things besides climate—accessibility, natural scenery, the kind of people in the neighbourhood, and so on. But keeping to climate as closely as we can, let us inquire if there are any places outstandingly better than others. Quito has a good name. High up on the Andes plateau in Ecuador it has a remarkable uniformity in temperature and weather generally, from day to day, and from season to season. The temperature throughout the year is much the same as in the south of England in May; a perpetual spring in fact. Its rainfall, however, is nearly twice that of London. It has, moreover, some of the unpleasant features of spring—violent changes from hot sun to chill wind, for example. Another distant place that gets great praise and has been suggested as a suitable permanent home for English settlers is Kashmir. Ellsworth Huntingdon, the geographer, says of that country:

"We are apt to think of Kashmir as part of India, and therefore as necessarily warm. As a matter of fact, it lies 34 degrees north of the Equator, in the same latitude as the northern part of South Carolina. In altitude it stands over 5,000 feet above the sea. Consequently the climate is comparatively cool. From November to March it is so cold as not only to be bracing but even to be rigorous. The spring and autumn are mild and delightful, and the summer is warm. The great amount of water spread over the plain for irrigation, and the summer storms on the mountains make that season damp, though little rain falls on the plain. . . . The temperate climate of the region, combined with the beautiful scenery, makes Kashmir a most attractive summer resort for the people of India, especially the English."

But we must not consider these places seriously. Kashmir is 5,000 feet above the sea, Quito over 9,000 feet. These elevations do not suit everybody—children, for instance. We must keep near sea-level and also we must keep near the sea. For if we get too far inland we have dreadful extremes between winter and summer, and even great changes within twenty-four hours or even great contrast between sunshine and shade. Sir Martin Conway wrote of the neighbourhood of Lake Titicaca in Peru:

"In the winter when the wind blows the frosts are yet more severe, the dry cold is so trying that even the natives cover up their faces in thick woollen masks, and wrap shawls about their heads and ponchos over their bellies. But as soon as the sun is a little way above the horizon, its direct rays scorch the traveller with their great heat, so that he soon begins to pray for the night, as the lesser evil of the two."

We must also examine critically the statements of enthusiasts for particular areas. There are seasons when the south of France or the north of Italy is perfect, but the whole year must be considered. A winter in northern Italy is nearly always the "coldest winter that Italy has ever experienced." In *The Times* we read the following about Capri:

"To-night I shall dine under an orange tree hung with lamps; afterwards I shall sit in a *loggia* and listen to Casella playing César Franck, or to Marinetti reciting 'Baudelaire.' The planet Mars will roll slowly down the southern sky, and the fishing-boats will twinkle until dawn."

But there is another side. In Mr. Kendrew's book we read about the exceedingly hot and dry wind coming from the Sahara which blows over Sicily and southern Italy in the summer. When it arrives "the air is misty, the sky yellowish to leaden, filled with heavy vapours through which the sun can be seen only as a pale disk if at all. Man feels languid and oppressed, and disinclined for mental activity, and animals suffer also from these hot winds. Everyone stays at home as much as possible and does nothing. When the sirocco is especially hot, its scorching breath does great injury to the vegetation; the leaves of the trees curl up and fall off in a few days. If the sirocco sets in when the olive trees and vines are in blossom, a whole year's harvest may be lost. It is usually heralded by a mist which rises over the southern horizon and overspreads the sky. At first the air is quite calm and the sea lies smooth like a mirror, till suddenly with mad gusts the wind bursts and the sea is lashed into waves."

Who indeed shall say where the best climate is to be found? Is it in Java on the Equator where the climate is good and where in addition one always knows when it is going to rain or what the temperature or humidity is going to be? Or in southern California with its four months of almost rainless summer, where the moving picture films are made. Might not even a claim be made for parts of our own country. Many travellers say the climate of the south of England is the best in the world. Charles the Second said so! South-westerly breezes for the most part, very mild winters, cool summers, damp air, much cloud, most rain in autumn; no high levels, no earthquakes, no tornadoes, no insect-pests—perhaps somewhere this might be bettered, but one need not go far from the south of England to fare worse.

A. S. Russell.

Greek Biology and Medicine. By Charles Singer, M.A., M.D. Illustrated. (Oxford: The Clarendon Press, *2s. 6d.*)

This excellent little book forms the first volume of a series of *Chapters in the History of Science* of which Dr. Singer is editor. It contains a reprint of his contri-

butions to the recently published *The Legacy of Greece*, together with a new section upon the biology of Aristotle. The whole is a clear, concise, and well-proportioned summary of a big subject.

The actual achievement of Greek scientific discovery is remarkable, but its yet more important legacy is the scientific attitude of mind, which is characterised by an eager curiosity in the disinterested pursuit of knowledge and the recognition that careful and accurate observation must furnish the basis of such knowledge. It was these qualities which made Aristotle "one of the very greatest investigators of living nature."

Until very recent times the scientific reputation of Aristotle has suffered from the results of his vogue in the Middle Ages, which, owing to their theological approach to the great philosopher, neglected some of his best work in favour of his weaker scientific speculations. Physiology, for example, he approached with philosophical prepossessions, and did not here make the first-hand investigation of detail the basis of his knowledge. But in natural history the careful accuracy of his observations has been strikingly confirmed by modern science. It was not until the nineteenth century, for instance, that the truth of his descriptions of the sexual processes of cephalopods (molluscs with distinct tentacled heads) or of the embryology of the dog-fish was rediscovered anew.

Dr. Singer rightly draws attention to the extraordinarily accurate detail in the representation of animal forms both in Minoan and in early Greek art. Here the artist was the forerunner of the scientist. I can add, from the experience of a prolonged stay in a Greek harbour, a reason for the predilection for forms of marine life which Dr. Singer notices. The crystal clearness of the water makes it possible to study marine life in a way which is impossible off our shores, and the beauty and interest of the scene to be observed by simply looking over the side of a boat is a sufficient incentive whether to artist or scientist.

Greek medicine and surgery equally displayed the scientific spirit. They broke away from the religious and magical treatment of disease, developed the inductive method of determining its natural causes, and based their precepts upon carefully recorded clinical experience.

W. R. HALLIDAY.

Practical Plant Biology: a Course of Elementary Lectures on the General Morphology and Physiology of Plants. By HENRY H. DIXON, Sc.D., F.R.S. (Longmans, Green & Co.)

This book embodies the result of many years' teaching experience gained in the School of Botany at Trinity College, Dublin. It consists of a series of thirty lectures designed as "an introductory course in Botany for Medical and other Science students." It is not, as the main title might seem to imply, merely a guide to the practical study of plants, but the practical work schedule at the end of each lecture is an essential feature and enables the student, as far as possible, to test the accuracy of the statements made by the lecturer. Admitting the force of the argument that medical students ought to have some acquaintance with botanical science, the difficult question at once arises: "What kind of course is best fitted to their needs?" Professor Dixon provides the medical student with an introduction to plant biology which is scientifically accurate, conceived on broad lines, and well written. He omits wisely, though one regrets that more attention is not paid to, the methods of response of plants, particularly the higher plants, to external stimuli. The first lecture deals with the use and construction of the microscope; this is followed by an account of the cell with special reference to the physical properties of protoplasm—the semi-fluid substance composed of oxygen, hydrogen, carbon, and nitrogen, which is the basis of life in plants and animals. In the two lectures on the yeast plant the student is introduced to crystalloids and colloids and other subjects of supreme importance. The unicellular plant *Chlamydomonas* serves as a basis for an account of sexual reproduction and for a lucid explanation of the truth of the statement that green plants not only supply themselves with food materials and energy, but are "actually the purveyors of food and of the energy of the sun to the whole of living matter." The lectures devoted to bacteria rightly emphasise the part played by these organisms in the general economy of plant life. In the lecture on the red seaweed *Polysiphonia*, a type which some of us would hardly venture to include in a course for beginners, the phenomenon of alternation of generations (i.e. the process by which one generation is produced by asexual spores and the next by sexual cells) is well treated. The alga *Volvox* serves to illustrate the differentiation of a plant into a mortal body or soma and immortal germ-cells. In the treatment of the higher plants Professor Dixon lays stress on the relation between structure and function and on features of special interest from an evolutionary point of view. The book concludes with two admirable lectures on Heredity and the Theory of Descent.

There must be many biologists who can recall the impression made upon their minds by the lecturer who first introduced them to the mysteries of the organic world. The first lecture on biology to many students is no ordinary event; it may initiate the development of a botanist or zoologist, or it may produce an opposite effect. The importance of stimulating the imagination of students on the threshold of a new subject can hardly be overestimated. A clear account of a plant cell, its contents and its work, a judicial statement of facts that have been demonstrated and of problems that await solution, attract the average student and place him in a position to appreciate the meaning of scientific methods and research. It is sometimes asserted that the more difficult and fundamental problems of life are beyond the grasp of the inexperienced, and therefore should not be included in an elementary course, but it is just those problems which produce keenness and stimulate thought; and, if treated with a due sense of proportion, they have a considerable educational value. Professor Dixon has produced a book which should do much to encourage the

study of plant biology on eminently sound lines; he has recognised the importance of bringing home to the beginner the necessity of visualising the living plant as a machine performing work and requiring energy.

A. C. SEWARD.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

The Story of Mankind. By HENDRIK VAN LOON. Illustrated. (George S. Harrap & Co., Ltd., 12*s.* 6*d.*)

Christ and the New Age. By "A MESSENGER." Edited by G. LEOPOLD. (C. W. Daniel, Ltd., 5*s.*)

Expressionism in Art: Its Psychological and Biological Basis. By DR. OSKAR PFISTER. Translated by Barbara Low, B.A., and M. H. Mügge, Ph.D. Illustrated. (Kegan Paul, Trench, Trübner & Co., Ltd., 6*s.* 6*d.*)

Health in the Factory. The Bournville Scheme. (Publication Department, Bournville Works.)

To the Romans. A Commentary. By ALEX PALLIS. (The Liverpool Booksellers' Co., Ltd.)

Massinger and "The Two Noble Kinsmen." By Prof. A. H. CRUICKSHANK, M.A., D.Litt. (Oxford: Basil Blackwell, 2*s.* 6*d.*)

Sketches from a Library Window. By BASIL ANDERTON, M.A. (Cambridge: W. Heffer & Sons, Ltd., 10*s.* 6*d.*)

Will o' the Wisp, or the Elusive Shakespeare. By GEORGE HOOKHAM. (Oxford: Basil Blackwell, 3*s.*)

Il Platanismo di Platino Sant' Agostino, Cartesio, Leibniz. Ing. GUETANO IVALDI. (Libreria Editrice "La Luce Del Pensiero," Napoli.)

Walter Scott's Scotland. By W. P. KER. (National Home-Reading Union, 1*s.*)

SCIENCE

The Advancement of Science: 1922. (John Murray, 6*s.*)

The addresses by the president, and by the thirteen presidents of sections, delivered at the British Association's meeting at Hull in September.

Geology of the Tertiary and Quaternary Periods, and the Palæontology, of the North-West Part of Peru. By T. O. BOSWORTH, D.Sc., M.A., and others. (Macmillan & Co., 45*s.*)

Beyond a few articles in magazines, little has been written about this interesting and economically important territory in South America. The geological surveys which Dr. Bosworth has carried out there in the last ten years are pioneer work, and the descriptions and conclusions therefrom, which make up four-fifths of his book, are wholly new. The four parts of the book which contain new scientific matter relate to the structure and stratigraphy of the Tertiary deposits, the geology of the Quaternary period, the geology of the desert, and the palæontology of the Tertiary deposits. The first three of these are by Dr. Bosworth, and the last by his four collaborators. The fifth part is of a much more popular character, and is a description of the occurrence and exploitation of the petroleum in the district. This is one of those books of which it may be justly said that no expense has been spared in its production. It is well printed, and very fully illustrated with 150 photographs, maps, and diagrams, and 26 plates. It is, of course, a book for technical readers only; a useful addition to geological and oil-field literature.

Elements of Plant Biology. By A. G. TANSLEY, M.A., F.R.S. (George Allen & Unwin, 10*s.* 6*d.*)

This book is intended primarily for medical students and others who do not necessarily intend to continue the study of botany, but who desire or are obliged to obtain some elementary knowledge of plants, particularly in relation to general biology. It will also be useful in the highest forms of schools, but it is not a work for the very young. It aims at providing a course of teaching which shall be as interesting as possible, and shall serve to introduce the student to the fundamental facts and principles of biology, both as part of his training for life, and more particularly as an introduction to the study of medicine. It is based on the first portion of the course in elementary biology at Cambridge (where the author is University lecturer in botany), for the preliminary examination in science and the first examination for the M.B. degree. This portion deals mainly with plants and serves to introduce freshmen, many of whom know nothing whatever about the subject, to biology. It differs from most textbooks of similar scope chiefly in two ways. It devotes more space to biological facts of general significance, illustrating them by a study of the lower forms of plant life. Second, it introduces the student early to the most important substances which make up the body of the organism, and to a brief consideration of some of the physical characters of organic substances and of protoplasm. At the end of each chapter are schedules of practical work, occupying about two hours, based on those in use in the course at Cambridge.

Progress and Science. Essays in Criticism. By ROBERT SHAFER. (Yale University Press; published in the British Empire by Humphrey Milford, Oxford University Press, 12*s.*)

Age and Area. A Study in Geographical Distribution and Origin of Species. By J. C. WILLIS, M.A., Sc.D., F.R.S. (Cambridge University Press, 14*s.*)

General Astronomy. By H. SPENCER JONES, M.A., B.Sc. (Edward Arnold & Co., 21*s.*)

Documents and their Scientific Examination. By C. AINSWORTH MITCHELL, M.A., F.I.C. (Charles Griffin & Co., 9*s.*)

Correspondence

ENGLISH PLACE-NAMES

To the Editor of DISCOVERY

SIR,

It is good news that the purely academic word study of such names is to be co-ordinated with the growing mass of local observation of facts concerning the places.

There is one factor in their meaning so important that in my observation it is the determining influence in at least one-third the place-names. And yet it seems to have been unsuspected and unknown until a year ago. Students have usually looked to some characteristic of the place itself, or of its history, to explain its name. The factor I refer to is the prehistoric straight-sighted trackway on which the place itself stands. Either the type of sighting point which formerly occupied the site, or some characteristic of the entire trackway, or the class of trader coming with his wares along the track, or the type of wares which he brought, are, I find, embedded in hundreds of place-names.

The miller at Rhos-goch (red-marsh) from whom I inquired the name of a lofty hill in sight at the head of a valley told me it was the "Red Hill," and added: "It always puzzles me why, because there never is anything red about the hill, at any time of the day or season of year." I was able to tell him that in the "Kiln-ground Wood" at Whitney-on-Wye (a few miles away) we had discovered the scrap-heaps of an ancient pottery making red-ware, and that I found radiating from this spot straight lines passing through "red" place-names such (to name one track) as Redborough, The Red Lay (a cottage), and the Red House, and that this one line was confirmed as being a track by the fact that it lies for two miles on a road marked "Roman" on the map. I cannot take space to detail how "white" roads radiate from such points of salt production as Droitwich, in straight-sighted tracks through the "White House," Whitwick, Wych Pass, Whitman's Wood, Whiteway, etc., and the kindred proofs (not yet so fully worked out) attaching to black, brown, and gold place-names.

I write this in a farm-house, one of four houses which in about half a mile come exactly in a straight line, which continued passes precisely through churches and other sighting points. The houses are "Lower Raven," "Upper Raven," "Blue Bowl," and "Upper Bowl." The two "Bowl" sites are high knuckles on the track. I have found the same place-name element in another part of the county linking up into a straight line at Bowley Lane, Bowley, and Bowley Field. I can surmise what it means; it relates either to a sighting point on the track (there is a Bowls Barrow in Wiltshire), or to wares brought along the track. In the former case it would indicate a shape, as I find evidence that the place-name element "bell" does. Valuable as is Professor Skeat's method of studying earlier forms of a word, it is only an adjunct in solving names going back to prehistoric times, not a basis.

If these two places were "bowl" places before the Romans came (as I feel sure they were), it is only an incident in their history to learn how the Anglo-Saxons rendered them.

Yours, etc.,

HEREFORD, ALFRED WATKINS.

September 23, 1922.

[As this letter raises some important points, the Director of the *Survey of English Place-names*, Professor A. Mawer, has kindly written the following note upon it:

It would be very difficult, without much more detailed evidence than is given in Mr. Watkins' letter, to form any just or final conclusion upon his theories. They are based entirely upon the modern forms, and quite apart from any other difficulties which might be raised about Mr. Watkins' views, it makes one rather uneasy that in the only one of his names for which I know of an ancient form, viz. Bowls Barrow in Wiltshire, the early evidence is in direct contradiction of them. The barrow is mentioned in a Saxon Charter (Birch no. 1215) preserved only in a fifteenth-century transcript (the identification is due to Dr. G. B. Grundy), and the form is *bodelusburge*. The first element is obscure, but it is clear that it has no connection with any word *bowl* or *bole* which Mr. Watkins postulates for the explanation of his series of names.]

INTOXICATING HONEY

To the Editor of DISCOVERY

SIR,

May I contribute a scrap of evidence in proof of the toxic qualities of the honey secreted by certain plants? In my garden in Kent is a flourishing toxic lime-tree which flowers and fruits from two to three weeks later than the British species, and which is raided by many species of bees. During one afternoon this season I counted the carcasses of over one hundred intoxicated bees on the lawn beneath the tree. They fall plumb, stagger or crawl a few yards, and die. If one should happen to recover, she (not unlike certain creatures higher in the animal world) at once returns to her cups. The honey appears to be less fatal to the hive bees, who furnish only about 5 per cent. of the victims.

Yours, etc.,

CAMBRIDGE. T. OKEY.

September 13, 1922.

Continued from p. 294.]
certain areas of the brain, the patient cannot restrain himself from waving his arms about when he hears music, emotional co-ordination and balance having been lost. These facts bring into strong relief the intimate connection between mind and its vehicle, the nervous system. We are not, however, within measurable distance of a complete comprehension of the functions of the brain. One portion is connected with hand movements, another with the interpretation of images on the retina of the eye, but when all has been told the greater part of the brain is included under the term "The Silent Areas," where stimulation in animals has no effect, and disease in man no specific symptoms. And, were we able to map out the brain to the uttermost, the problem of consciousness would not be solved. Some day, as the great French physiologist Claude Bernard prophesied, we may reduce a symphony of Beethoven to the vibration of molecules in the brain—but we will not have elucidated all the mysteries of harmony. Behind the most intimate analysis of psychology and the geography and mechanics of the brain, human individuality still remains the province of the poet rather than the scientist.

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Editorial Notes

THE first organised gliding-tests in England have been concluded, and have astonished even the experts by the revelation of what is possible in a district not naturally the most suitable for the purpose. A mere onlooker is left with a feeling of admiration tempered with almost superstitious awe in contemplating such successes as those of Maneyrolle, Raynham, and Gray. For the personal factor—the flying sense—must be supreme in gliding, far more so than in the piloting of a modern aeroplane, which can be flown for miles without the pilot having to touch a lever. The glider, of course, has a steady wind for the most part to deal with—gusty weather is not for him. All the same, the air near the ground is never uniform, and the failures and minor accidents of the meeting proved more clearly than words can what difficulties the successful had to surmount, and what a delicate sense of balance and instantaneous action in quickly shifting circumstances are called for.

* * * * *

How much do we even now know of the varied conditions of the air within a thousand feet of the ground? Any airman will tell you that there are queer uncharted spaces in the air, and that now and again circumstances arise utterly unlike the normal. On one occasion during the war, in France, without any warning or any movement of the controls, a certain pilot's machine slowly assumed a "bank" of 45 degrees, in a manner completely unlike the ordinary "bump," which is so familiar to all who fly. Inexplicable disasters to experienced pilots are still an all too common feature of the conquest of the air; and some personal experience of seeing aeroplane accidents have convinced the present writer that the air is as full of hidden dangers as is the sea. It is such uncharted and intangible dangers that gliding may reveal to us. For the sea has been yielding its secrets ever since he of the oak and triple bronze first trusted his flimsy craft to it; but the air is an element which has been tested only by the last few generations.

* * * * *

Every week brings its fresh theory of the cause and nature of cancer, but not one of them has as yet yielded a hint of a cure. Some of these theories are fanciful—the mere brain-spinning of the arm-chair scientist. Such a one is that of a French writer who suggests that it is due to the union of a primitive organism—which has strangely eluded observation—with a cell of the body, in a species of unholy matrimony. Re-born, the cell sets out on the proliferating road which is typical of cancer, knowing neither end nor boundaries. He suggests that the theory might be tested by confining together in test-tubes living cells of the body and various arbitrarily selected organisms, in case one of them proved to be the culprit. But it is not probable that the matter will be put to the test.

* * * * *

A more reasoned hypothesis is presented by Sir George Beatson,[1] a name intimately associated with the problem for many years. He inclines to the opinion that it is to be solved by a closer investigation of the colour-bearing cells of the body, namely the pigment-cells. These are present in the skin (especially of negroes), in the eye, and in other places. There is evidence that cancer is commonest at the period in life when the body pigments are diminishing, when the hair is growing white and the skin often darker in small patches. Some cancers, too, are definitely composed mainly of pigment-bearing cells, and these

[1] The *Lancet*, September 23, 1922.

are the most malignant of all. The theory is only a theory as yet; but it is a deduction from a great many years of clinical experience—without which laboratory work alone can never hope to discover much.

* * * * *

The question to be solved is: "Why do some cells of the body suddenly begin unrestricted multiplication?" But there is another equally great mystery associated with cell-growth: "What factors ordinarily limit it, and why does the normal, well-intentioned cell divide and subdivide only to a certain definite degree?" There are, moreover, new growths of the body which, though beginning, as does cancer, in an untoward burst of proliferative energy, never invade other tissues, and never scatter their seeds broadcast through the body. In what relationship do such growths stand to cancer, and, most vexed question of all, can they ever become transmuted into cancers? The questions are easily asked—but the answers are not so readily found.

* * * * *

Marcel, arch-interferer with the ways of nature, has been amongst us, and has gone his way again. Why is it that humanity should crave for curls of oval shape, like a negro's, rather than for the fair, round symmetrical locks of the Western world? There is room for a scientific sequel to Darwin's *Expression of the Emotions in Man and Animals*, and we might entitle it *The Suppression of the Expressions in Man*. Beauty-spots—those curious bits of black plaster that may be seen on the portraits of great ladies of the eighteenth century—are as worthy of analysis as the snarl; the Marcel-wave as the elevation of the eyebrow in surprise. Deep in the soul of the community there seems to be cherished a conception of ideal beauty which includes such things as black spots, eccentric and undulating hair, carmine lips, and eyebrows too dainty to be seen. Whence comes this desire to fly from realities? Had Aphrodite lips significant of a cardiac lesion, and did Helen's hair wave? Was there a Greek Marcel, and did Achilles ever learn such lore when he sojourned among the maidens?

* * * * *

After all, hair is a strange survival from antiquity. There is a muscle to each hair, and a nerve too, yet we never use one of them save when Pickwick's fat boy and his sort are displaying their peculiar capacities. If our beauty seekers are chasing the phantoms of age-old æsthetic principles, perhaps it is not inappropriate that they should choose for their care such a poor scant relic of antiquity as the human hair, and bestow on it their meed of such undulation as may once have pleased our long-haired ancestors of the caves and the forests.

The Economic Development of Central Australia

By O. H. T. Rishbeth, M.A.

Reader in Geography at the University College of Southampton

In the true geographical and economic sense, Central Australia consists of an area of over 300,000 square miles, shaped somewhat like a bean, with its convex curve northwards. It stretches, from the Western Australian border at about latitude 25° S., east by a little south to include the south-west corner of Queensland and the north-east corner of South Australia. The northern boundary is roughly marked by the line Treuer Range–Barrows Creek Station–Boulia, while near the centre of the southern concave boundary is the rail-head, Oodnadatta, and Lake Eyre.

The development of Australia has proceeded centripetally, though so far mainly from the south and east parts. The early squatter and miner of the oceanic fringes have given place to the agriculturalist; the sheep-rearer has advanced through the ranks of the farmers and occupied the next inner concentric ring: the cattle industry has gravitated towards the centre and the inner north; the miner is eclectic.

These are, of course, generalisations, for few land industries are mutually exclusive, especially in Australia, where a rather erratic climate encourages multiple pursuits. Indeed, one of the economic tests of Central Australia will lie in its capacity to produce either a constant sum of varied products or a relatively fixed quantity of one or two.

The response to this test is already fairly clear: Central Australia will be mainly a pastoral region—with probably a good range within those limits—and in the second line a producer of minerals. The "dead heart" of Australia has become a legend, and even in Australia "distance is often synonymous with aridity." But the heart of Australia needs no apologies. Beauty it has and riches, but its beauty is fickle and its riches are to be won sternly.

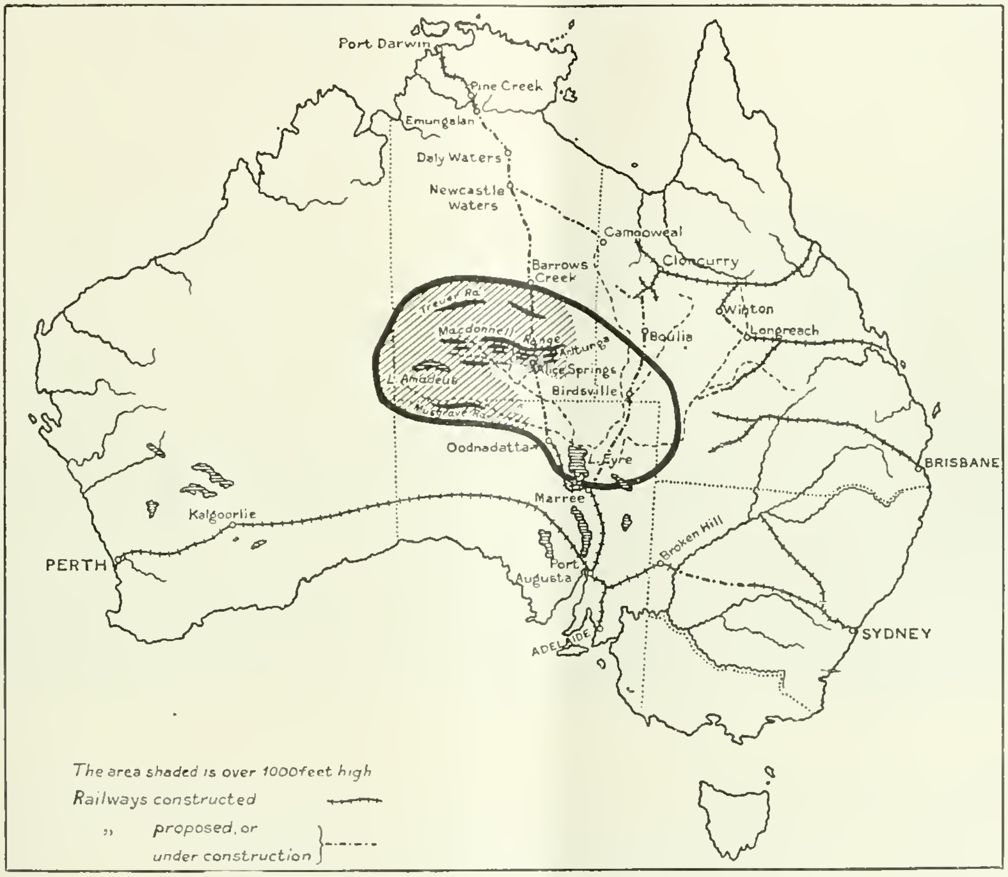
The days of the pioneer explorers and nameless prospectors are gone. The debt Australia owes to those heroic men, the mighty obstacles they overcame, their sufferings and our reward, should not blind us to the essential untrustworthiness of many of their conclusions. The British settler has much to unlearn in Australia. Judged by northern standards, a large portion of the continent is truly desert, but the young Australian has seen thousands of square miles of "desert" blossoming into wheat and cattle and

fruit land. The heat which blazes in the harrowing tales of our forefathers is no more than that which thousands of Australians live and thrive in to-day. It is not much greater, in fact, than that of more southerly and settled parts, and, though there are extremes of heat and cold, both are lightly borne because both are so dry. The winter climate is healthy and invigorating in the extreme. Certain parts suffer from severe dust-storms, and flies and mosquitoes are, in some seasons and places, sore plagues.

As far as concerns surface features, Central Australia is not badly off. The east half consists of a vast low-lying plain varied only by rocky ridges, isolated flat-topped hills, and occasional belts of sand-ridge country. The west half is a plateau, with an average elevation of about 2,000 ft., cut across by numerous parallel ridges, running from east to west, notably the Macdonnell and the Musgrave Ranges, which rise to about 5,000 ft. North to south communications are not much impeded by these ridges, because most of them are low, while the Macdonnells are cleft across north to south in many places by striking steep-sided gorges, offering here easy passage and there splendid sites for dams. More serious are the broad, sandy river-courses and wide lowland flats subject to sudden devastating floods. These, sand-hills, dust-storms, and the frequent lack of a natural supply of non-mineralised water for boiler use, are the chief physical difficulties facing the railway and road engineers. For other means of transport the conditions are often trying, but seldom really difficult.

It is rainfall and geological structure which really stamp this region with its character. The Clerk of the Weather has not been kind to Central Australia. As one writer puts it : "Central Australia is a forecaster's paradise! . . . [He] could predict fair weather every day of the year and only be wrong four times in a hundred." The driest part of Australia lies around and west of Lake Eyre, and the whole region except the north lies within the 10-in. line and is, therefore, in current climatological language, "arid" or "desert." It is just too far north to get much winter rain from the south, and far enough south to get only the fringe of the north monsoonal rains. Even worse, the rainfall is most erratic : the heart of Australia is not dead, but it is very fickle.

This has been a great curse. It accounts for the



CENTRAL AUSTRALIA (MARKED WITH THE HEAVY LINE).

extraordinary divergence of accounts of the country given by travellers. One man sees a pastoralist's paradise, with waving prairies, abundant pools, green scrub, and plentiful life; the next a withered wilderness filled with dust and whispers of death. It accounts for the successive waves of settlement—the brave and hopeful push out into the "Far North," the weary and bitter return. It accounts for the "gamble with nature"—the overstocking in good seasons and "taking the risk." And it accounts now for the somewhat selfish "ca' canny" understocking and the holding of too much land unimproved. There can be no security in Central Australia until the water-supply is secure.

What Nature withholds with one hand she gives with the other: it is to the geologist that the Australian turns for comfort in some of his sorest difficulties. In Australia geology is a first-line national service, and

A GORGE IN THE MACDONNELLS, WESTERN AUSTRALIA.
(By courtesy of the High Commissioner of Australia.)

geology speaks concerning Central Australia with a voice restrained, but not pessimistic.

The ancient rocks which form the ridges of Central Australia are frequently metalliferous: wide areas have been proved to contain good medium-grade ore: e.g., in the vicinity of Arltunga, gold and mica; at Hatches Creek, wolfram. But capital and then machinery, timber, water, and white labour are required to develop these deposits, and capital will not come until the enormous transport costs are reduced. Besides minerals, these ancient rocks generally provide belts of fertile soil, with a good water-supply around their bases, and between the parallel ridges of the Macdonnells are numerous rich, if still dry and "unimproved," valleys.

But by far the greater part of the area is covered with soft and relatively recent formations—sandstones, limestones, clays, and marls—sometimes forming wide alluvial plains. Undeniably there are considerable waste or semi-waste areas—sand and spinifex country with very poor scrub—especially in the western and south-western parts.

These soft formations have three qualities of capital economic importance:

(1) They are often extremely rich and support a drought-resisting vegetation unsurpassed as fodder. The horses and cattle of Central Australia are of notable quality and condition. By careful selection among these desert grasses and bushes, by burning off poorer sorts (e.g., spinifex), the quality of pastoral land can be greatly improved.

(2) They are extremely responsive to climatic influences. Like most desert soils—dry, long fallow, sun-bathed—they are, if given water, capable of astonishingly rapid productivity. "In a night" the bare clay-pans fill, the grasses rush out and the sad scrub shines out as bright park lands. In places, 3 in. of rain at the right season are held to be sufficient for a year. At Alice Springs dates, figs, grapes, oranges, and green vegetables have succeeded admirably.

(3) They store water. Even sand-hills act as reservoirs and for some time after rains yield "soaks." The opening up of underground water is the first grand solution of Central Australian pastoral problems. Conservation of surface waters by means of dams, catchments, underground tanks, etc., is important, particularly in the Macdonnell Ranges, where large "gravitation" dams can easily be constructed, and the valleys thus rendered highly productive. Important too is the fencing in of existing pools and "native wells" and providing them with cattle ramps, for this may treble the lasting capacity of a water-hole and save many cattle which otherwise get bogged and die. But nearly all natural surface waters are more or less evanescent; not so subterranean supplies. These, though they vary much in various localities, fall into three main classes. Many quite shallow wells yield almost inexhaustible supplies of pure water. A second class of well is sunk to 50–150 ft., and these tap the "ground water" of a district, though this water is frequently hopelessly saline. Thirdly, there are the true artesian supplies from depths of 400–2,000 or more feet, generally highly mineralised and unfit for agriculture, but good for stock. The west boundary of the great Queensland artesian basin lies not far west of Oodnadatta and covers most of the east half of our area, thus constituting a radical difference between the east and west halves. Artesian water is by far the most valuable for pastoral purposes.

A beginning has been made, but much remains to be done to develop fully these underground supplies. Systematic well location and construction are necessary. The flow of artesian waters must be regulated

and distributed to good advantage. Cattle can range ten miles and sheep about five miles from their water supply, and after rains, when herbage is juicy, cattle may range even to fifteen miles. Wells then act as centres, and sometimes may save fencing—an important consideration in a country liable to bush-fires. Rabbits and dingoes must be systematically and uniformly attacked; stock routes with permanent wells opened up. The land must be scientifically parcelled and put out on permanent lease, and improvement of leased lands and adequate stocking must be stipulated in return for Government aid in well-sinking, etc. The carrying capacity and suitability of various lands for various animals—horses, cattle, sheep, goats, Angora goats—must be tested. All this will stabilise the pastoral industry and probably quadruple its output—an enormous gain over such a wide area.

£600 WORTH OF TIN COMING INTO MARBLE BAR FROM WOOLYELLA, WESTERN AUSTRALIA.
(By courtesy of the High Commissioner of Australia.)

But all this depends on better railway communications. At present the pastoral, like the mining industry, suffers under crippling disabilities, especially in marketing its products. Also droughts, though recurrent, are not universal at one and the same time. One of the great means of fighting droughts will be strategic pastoral railways, whereby stock can be shifted rapidly from area to area. Central Australia, properly linked, will play a large part in this strategic scheme. Australia is taking its north to south transcontinental railway seriously, and two main schemes hold the field. They are based on the two natural divisions of Central Australia indicated above. The one plan is to complete the Oodnadatta to Pine Creek railway roughly along the Overland Telegraph Line (western route); the other would take the line eastwards from Marree (Hergott Springs), up through Western Queensland and then curve westwards towards Darwin. This would undoubtedly open up much better and more pastoral country, and would probably be cheaper. Under this scheme the Oodnadatta line would also be continued to Alice Springs, thus tapping west Central Australia by a branch route. This much seems certain: the fine pastoral areas of the north-eastern portion of South Australia and Western Queensland will have to be opened up and linked somehow with the north to south railway system, because the economic drainage of the whole of Central Australia is eventually bound to follow the main lines of geographical configuration. That is to say, two systems, one from the north-east and one from the north-west, will unite somewhere south of Lake Eyre and, forming a "Y," will flow south to Port Augusta, which is capable of becoming a first-class deep-water harbour. Eventually, also, the northern fringe of Central Australia may drain economically northwards towards Asiatic markets.

Besides railways, greatly improved telegraphic, telephonic, and postal services will be needed if these lonely spaces are to be humanised, and light railways, motor traction, and even aeroplanes, will no doubt play their part.

Perhaps the most fascinating aspect of Central Australian development is its essentially pan-Australian character. Australia has increasingly to be thought of as a unity, and the development of Australia as an economic whole is making rapid strides. The solution of Central Australian problems is bound both to typify and to reinforce this tendency. Moreover, though distinct, the problems of Central Australia are largely bound up with those of the Northern Territory,

and the policy adopted in the one case will vitally affect development in the other.

The following works, dealing wholly or in part with Central Australia, will be found useful and interesting:

J. W. Gregory: *The Dead Heart of Australia* (1906).
Spencer: *Narrative of the Horn Expedition* (1896).
Spencer and Gillen: *Across Australia* (1912).
T. E. Day: "Explorations in Central Australia" (*Bulletin of the Northern Territory*, No. 20, 1916).
J. J. Waldron: *Central Australia* (1916).
Griffith Taylor: *Australian Meteorology* (1920); also his article in Meredith Atkinson's *Australia* (1920).

The reader might also refer to the columns of *The Times* (July 11, 16, 17, 1922) for particulars of Mr. McCallum's recent transcontinental journey; the *South Australian Register* (May 5, 1922) and *The Times* (November 3, 1922) for an account of a recent report on the proposed transcontinental railway; and Professor Hudson-Beare's presidential address on "Australian Railway Problems," at the British Association's recent meeting at Hull.

Revelations Concerning the Triple Alliance

By R. B. Mowat, M.A.

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TILL the fall of the Habsburg Empire the Triple Alliance was a mystery to the European public. Its contents had never been officially published, and no definite knowledge of it had leaked out from the diplomatists. For years it kept the curiosity of historians on edge, and the most ingenious attempts were made in France, Russia, Italy, and elsewhere, both by professional students and publicists, to reconstruct its terms from information contained in contemporary history. But all the essays and monographs came to very little result; and meantime those statesmen and the official world of the "Triplice" remained perfectly impassive; nothing was divulged, and none of the challenging statements made by outsiders was contradicted. Down to the outbreak of war nothing was known—"an honourable testimony to the discretion of a class against whom the reproach of indiscretion has so often, and not unjustly, been made."

Even during the European War very little knowledge of the Triple Alliance came to light. In May 1915, after the entry of Italy into the war against the other two great members of the Triplice, the Austrian Government published four articles (Nos. I, III, IV, and VII). But nothing was said about the other articles, nor was there anything to indicate whether this was the only treaty forming the Triple Alliance. When Rumania entered the war in 1916, she surprised historians by stating in her manifesto that she had been a member of the Triplice, which, however, she considered to have been dissolved when Italy declared war upon Austria in 1915.

When at the end of the war the revolution occurred in Vienna and the Habsburg régime disappeared, the Austrian State Archives were opened to that eminent writer on diplomatic history, Professor Pribram. The result of his researches was a work entitled *The Secret Treaties of Austria-Hungary*, containing both the texts and a history of the negotiations which produced these texts. That part of Professor Pribram's work which gives the texts of the various treaties has been published, with a translation, by the Harvard University Press. Thus through Professor Pribram's work the veil has at last been lifted, and the whole body of the Triplice exposed to view.

From the account now before the public (an account which has not attracted the attention which it deserved) two facts stand out pre-eminent. One is, that the Triple Alliance contained not one, but several treaties at the same time. The second fact is, that it was never a very stable nor a very potent alliance, but that the really important diplomatic instrument was the Dual Alliance of 1879 between Germany and Austria, out of which the Triplice grew, but which was never superseded by the Triplice. To show the importance of the Dual Alliance it need only be said that it was according to its terms (not those of the Triplice) that Germany supported, and went to war on the side of, Austria in the crisis of summer 1914.

The text of the Dual Alliance has long been known. The circumstances out of which it arose are also known. Prussia, by the war of 1866, had driven Austria out of the Germanic system. Henceforth Austria ceased to have influence in Germany; at the same time she had lost her Italian provinces; there was no other path of ambition left to her but to exploit her Balkan claims. Nevertheless, although impotent in Germany, Austria was still a powerful military state, with an admirable strategical position in Central Europe. Hence her friendship and alliance, if they could be secured, were very important to Prussia. On the other hand, Prussia's friendship was important to Austria, always in danger of war with Italy (over the Trentino) or with Russia (over Galicia or over some Balkan question).

Bismarck would have liked to be friends both with Russia and Austria; but if he had had to choose between the two, he would have taken Austria, because Austria was the only Power who would have supported him in the war that he expected to come any day with France.

It so happened that by the year 1879 Russia was on rather bad terms both with the German and the Austrian Empires. Bismarck had been very displeased by the Russian Government's coolness (not

to say opposition) during the Franco-German "war scare" of 1875, which ended quite peacefully. Austria was also displeased with the influence which Russia acquired in the Balkans in the Russo-Turkish War of 1877–8. She feared that Russia might try to take from her the Turkish provinces of Bosnia and Herzegovina, which she had gained at the Congress of Berlin. So, out of the estrangement of both the Central European Powers from Russia, grew the Austro-German Alliance, which was signed by Prince Henry VII of Reuss for Germany, and by Count Andrassy for Austria-Hungary, at Vienna, on October 7, 1879.

The important part of this treaty was Article I, which stated that if "one of the two Empires be attacked by Russia, the High Contracting Parties are bound to come to the assistance one of the other with the whole war-strength of their Empires." Article II stated that if one of the two Empires were attacked by another Power which was directly or indirectly supported by Russia, the *casus fœderis* would also arise. Thus the German and Austrian Empires were very closely linked together; an attack from Russia on either party would bring both into the struggle; and, after the conclusion of the Franco-Russian Alliance in 1894, an attack by France on either Germany or Austria would involve hostilities with both.

This momentous Austro-German Dual Alliance was kept secret till 1888, when, on February 3, it was published simultaneously in Berlin and Vienna. There was one omission, however, from the text—Article III, which dealt with the duration of the treaty. This obscurity has now been cleared up. The treaty was, in the first instance, for five years; it was renewed again in 1883, and again in 1889, this time for three years. In 1902 a protocol was concluded by which the Alliance was automatically prolonged for periods of three years unless notice were given, at stated times within one of the periods, for considering its termination. In summer 1914 the Dual Alliance was in full force, and the mobilisation of the Russian Army in the provinces contiguous to Austria was accepted by Germany as the *casus fœderis.*

The Triple Alliance was a much less important affair; Professor Pribram's researches have fully justified the calmness, almost amounting to indifference, with which British Secretaries of State regarded it. It never superseded the Austro-German Dual Alliance: it was something additional to and outside it. Until 1888 the other members of the Triplice (i.e. Italy and Rumania) did not know of the existence of the Dual Alliance.

The Triple Alliance was founded by a treaty concluded between Germany, Austria, and Italy, at Vienna, on May 20, 1882. It was a kind of "insurance society" made by individuals who had no particular interest in each other. Italy at that time had very strained relations with France, chiefly because of the expansion of French power in Tunis. Therefore Italy wanted the support of Germany. But she would not get Germany's friendship while remaining unfriendly with Austria. Austria on her part was willing, even anxious, to have the alliance of Italy to prevent her from stirring up trouble among Austria's Italian subjects in the Trentino, Istria, and Dalmatia. Germany, of course, was glad to get Italy's promise of support, as the fear of a Franco-German war for Alsace-Lorraine was always in the minds of German statesmen. Italy, in point of fact, was the party who was least anxious for the alliance, and this explains why, in 1882 and at the subsequent renewals, she obtained the best terms. The Treaty of Alliance bound Austria and Germany to support Italy with their whole strength if she were attacked by France; and it bound Italy to support Germany only (not Austria) if Germany was attacked by France. Italy was not bound to support Austria if Austria were attacked by Russia singly.

Thus it will be seen that Italy got very large guarantees from the Alliance—the support of two great military empires—and Germany got a guarantee of moderate strength—the military power of Italy, which was rather far off geographically—while Austria got nothing but benevolent neutrality unless she was attacked by more than one Power. Thus the security of Austria lay, if anywhere, in the Dual, not in the Triple Alliance. The first Treaty of the Triple Alliance was to last for five years. Attached to it was a declaration made by the Italian Government, with the agreement of the other two signatory Powers, that the Treaty of Alliance could not "in any case be regarded as against England." The Austrian and German Governments made identical declarations. These declarations, like the text of the treaty, were secret; even the English Government knew nothing of them. Their secrecy is, to some extent at least, a proof of their sincerity.

One interesting point about the Treaty of Triple Alliance is its preamble, which stated that its objects were "to increase the guarantees of peace, to fortify the monarchical principle, and thereby to assure the unimpaired maintenance of the social and political order," in the three contracting States. The treaty was therefore a kind of "Holy Alliance," except that it claimed no right to interfere with the social and political order of other States. The treaty was to last for five years.

The Alliance of 1882 was made by a single treaty. The renewal on February 20, 1887, required three treaties. The first, which was signed by all three contracting parties, merely repeated the text of 1879.

The second was signed by Austria and Italy alone: it concerned the Balkans, and stipulated that, if either Austria or Italy should find itself compelled to modify the *status quo* in the Orient, either by a temporary or permanent occupation of part of it, this should only take place after a previous agreement between the two Powers based on the principle of a reciprocal compensation. A third treaty between Germany and Italy engaged the former to aid Italy if this Power should find it necessary to take action against France in the Vilayet of Tripoli, in the Moroccan Empire, or even "in French territory in Europe." And if, at the termination of such a war, Italy should "seek for territorial guarantees with respect to France" (i.e. if Italy should wish to annex a part of Savoy or Nice), Germany would present no obstacle.

Thus it will be seen that Italy at the renewal of the Triple Alliance considerably increased her advantages: she got an Austrian guarantee to share in any partitions in the Balkans, Adriatic, and Ægean, and a German guarantee of support to any territorial aims at the expense of France either in Europe or Africa. In return she gave promise of support to Germany in a French war, but only if the war was one of "aggression, without direct provocation, of France against Germany." To Austria, Italy promised military support only in the event of an attack by two Powers.

On October 30, 1883, Rumania had joined the Triple Alliance by a dual treaty with Austria, according to which the two Powers agreed to assist each other, if either was subjected to an unprovoked attack by a third Power. By a separate treaty of the same date Germany undertook the same obligations. Italy did not accede till May 15, 1888, and even then only so far as to undertake "to take counsel" with Austria and Rumania in the event of the *casus fœderis* taking place. The engagements of the three Powers with regard to Rumania were renewed in identical terms in 1892, in 1902, and in 1913. This last renewal was for a term of seven years.

The third Treaty of Triple Alliance was concluded on May 6, 1891, at Berlin. For this occasion the three treaties of 1887 were fused into one tri-partite instrument. The terms remained practically unchanged; the three Powers, though in the same treaty, undertook different obligations to each other. Article IX stipulated that, if Italy found it necessary to take measures to change the *status quo* in North Africa (Cyrenaica, Tripolitana, and Tunisia) with the support of Germany, "the two Powers would seek to place themselves likewise in agreement with England." Great Britain had already (on December 12, 1887) given her adhesion to "nine points" of the Austrian and Italian Governments relative to the maintenance of the *status quo* in the East (i.e. the Balkan régime). When the Triple Alliance was renewed in 1891 a protocol was attached to the treaty stating that the High Contracting Parties would exert themselves to obtain a similar accession of England to the treaty's stipulations concerning the North African territories. But Great Britain gave no such adhesion. Nevertheless she had come fairly near to the Triple Alliance, especially at the time of the Heligoland-Zambezi agreement of 1890. In 1891 she had the chance of definitely coming within the Triplice orbit, but took no action.

From this time the Triple Alliance became of less and less importance; and although renewed by a tripartite treaty on June 28, 1902, and by another tripartite treaty on December 5, 1912 (both times with the provisions unchanged), it was of little effect. The reason was that Italy's position in Europe was no longer consistent with the Triplice. She had got over her trouble with France, probably owing to some understanding which has never come to light, that France would not object to her annexing Tripoli. She had given up any idea of recovering Nice and Savoy, but on the other hand her longing to unite with her nationals who were under Austrian sway was stronger than ever. Moreover, the Italian and Austrian Governments found almost endless cause of friction in their respective handling of the Balkan clauses of the Treaty of Triple Alliance. On the side of Germany, too, the situation of the Triplice was no happier. Italy had always been very careful to insert saving clauses in protocols with regard to England; and in 1896 she had gone so far as to notify Germany and Austria that she could not take part in a war against England and France jointly. Although the Central Powers refused to take note of this declaration, they must have understood that all subsequent renewals of the Triple Alliance were subject to this condition. Thus the Triplice became of no military importance; it was useful as constituting a friendly group of States, with most favoured clauses as regards commerce; but in military affairs it no longer counted. Everything turned upon the old Austro-German Dual Alliance.

AUTHORITIES

Owing to the secrecy which was maintained over the Triple Alliance till 1919, all the standard works are in this respect almost purely speculative. The full texts will be found in Pribram: *The Secret Treaties of Austria-Hungary*, vol. i, with translations by D. P. Myers and J. G. D. A. Paul (Harvard University Press, 1920). There is a good short introduction to the texts. Some of the later documents were also printed from the archives of the German Foreign Office by Kautsky, in *Die deutschen Dokumente zum Kriegsausbruch* (Charlottenburg, 1919), band iv. The memoirs of the Baron von Eckhardstein (1921) also give some facts about the efforts of the German Government to obtain the alliance of England just after the conclusion of the Austro-German Dual Alliance.

Ink Pigments in Writing

By C. Ainsworth Mitchell, M.A., F.I.C.

Police reports abundantly prove that the crime of forgery frequently engages the attention of our magistrates. This is not surprising if we remember that the means are in the hands of all who can write, and that bankers' cheques are a common medium of exchange. The evidence usually demanded by the prosecution is that of the handwriting expert, who bases his opinion on the form and peculiarity of the writing; but there is evidence of another kind, less known to the public, namely the chemical examination of the ink or pencil marks on the documents, which is often not only more trustworthy but actually throws more light upon the mystery. Suppose, for example, additional letters have been added to a cheque, it is comparatively easy by chemical means to ascertain whether or not the interpolated characters have been written with the ink used for the body of the document. There are other methods, of course, which are useful in deciding on the genuineness of documents, photography for example, but in this article we shall confine ourselves to describing what is known about, and what can be learned from, the ink pigments which are used in writing, partly as matters of interest, and partly in their relation to the genuineness of documents. For this purpose some characteristics of ink must first be described.

The principal kinds of inks employed at the present time are known as carbon ink, iron-gall ink, and aniline ink. There are others, but these are the principal three. The ink in common use in this country, the familiar "blue-black," is a mixture of iron-gall ink and a blue aniline ink; it is best to discuss it, therefore, after its constituents have been described.

Carbon ink is not generally used for writing purposes in this country. Such inks are used in Europe only in the form of Indian ink or "safety" inks, to which lampblack, which is the basis of all carbon inks, has been added to render the pigment proof against the action of chemicals. Carbon inks, however, are still used in Egypt and in the East for ordinary writing, and are in general use everywhere for printing. The characteristics of a carbon ink are (1) its colour—a black which does not, in most cases, vary with time, and (2) its resistance to bleaching agents. An ordinary blue-black ink, for instance, may be bleached by a solution of the chemical sodium hypochlorite; not so a carbon ink. The two are consequently easily distinguished.

Carbon inks are the oldest class, and were known to antiquity. A chemical examination of ancient writing has thrown interesting light on their use in the past. Sir Humphry Davy found that the ink on the papyri unearthed at Herculaneum was a carbon ink with no traces of iron in it. He concluded that the Romans had not discovered iron-gall inks. Astle, who was Keeper of the Records at the Tower at the close of the eighteenth century, attributed the blackness of inks upon old manuscripts, dating from the ninth to the fifteenth century A.D., to their being carbon inks; but Blagden, who examined them chemically in 1783, failed to "find any trace of a black pigment" (due to carbon), but found iron in every case. The conclusion he drew, therefore, was that these ancient writings must have been done with the second class of inks, the iron-gall inks in common use in his own day. It is probable that the transition from the old

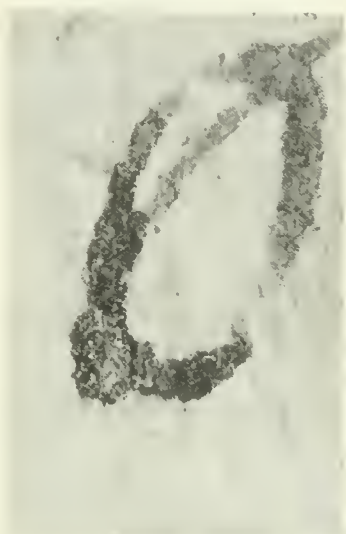

Fig. 1.—Iron-gall ink. Period 1723.
Magnification 20.

carbon inks to the modern iron-gall inks occurred in the seventh or eighth century A.D., although for some centuries later both were in use. An Egyptian document recently examined by Mr. Lucas, a portion of the Old Testament in Arabic (A.D. 1312), was found to have been written in two kinds of ink, one a carbon ink, the other an iron. These inks were not mixed, but used separately. Ancient carbon inks are not always as black as might be expected, being occasionally yellow or pale brown. Sometimes this brown colour is due to iron compounds, sometimes to those of other elements, but it is probable that these bodies were not deliberately mixed with the carbon for a specific purpose, but were mere impurities associated with the grade of carbon used in making the ink.

Iron-gall ink forms the principal, but not the sole, constituent of the ink in general use in European countries. It is made from a compound of iron, known

as ferrous sulphate or copperas, an extract of nut galls which contains tannin, and a solution of gum. This mixture when freshly made gives only a very faint colour on paper, but it has the property of

Fig. 2.—Blue-black iron-gall ink five years old, showing dark margins caused by pen nib. Magnification 20.

gradually combining with the oxygen of the air to form a compound which is coloured black. It first forms a tannate of iron containing about 5·5 per cent. of iron, and, until this tannate has been formed, the writing is to some extent soluble in water, and so capable of yielding a copy when pressed with moist absorbed paper. Some inks, indeed, are capable of yielding a copy in this way for a week or more. After this insoluble tannate has been formed, it combines further, but slowly, with the oxygen of the air to form a second tannate containing about 8 per cent. of iron. The writing then becomes stable. This body is relatively insoluble in water and dilute acids, and is of a resinous nature. Consequently an iron-gall ink after, say, six months (before the second tannate has been formed) will not behave in the same way, when treated with certain chemicals, as the same ink which has had eight or ten years in which to become stable. This property, as will be described later, is employed in examining suspected documents.

There are changes, too, which may be seen with the naked eye, or, more closely, with the microscope. At first, as has been said, the writing is almost colourless, but in a week or two if the written page be left open to the air and strong light, or in a year or more if it be written in a book and the book kept shut, the writing appears black. This progressive change of colour is entirely absent in pure carbon inks. Iron-gall ink is also easily distinguished from carbon inks in that it is easily bleached by some bleaching agents. Its characterictics, therefore, are three: (1) its change of solubility in acids and water with time; (2) its gradual change of colour to black with time; and (3) its property of being bleached by suitable bleaching agents.

The class of aniline inks is that most recently discovered. These inks are made from aniline dyes, the first of which, mauve, was discovered in 1856. These dyes now provide us with inks of all the colours of the rainbow. Eosine is the commonest basis of red ink, methyl violet of violet ink. But for ordinary purposes of writing, aniline dyes by themselves are not used in this country very much. In the East, on the other hand, they are largely used even for important documents like wills, promissory notes, deeds of sale, and receipts. They have the demerit of fading on exposure, but this change with time is not a progressive one like that of iron-gall inks; the nature and the extent of the exposure conditions the appearance of the ink much more than mere age. Many aniline inks are easily bleached when treated with suitable chemical reagents, and others change colour. The characteristics, then, of an aniline ink are: (1) it is of modern manufacture; (2) its age cannot be told from its colour; (3) it is easily bleached or its colour is easily changed by certain chemical reagents.

A few words now about blue-black writing ink. In former days iron-gall ink sufficed for the purpose of writing, the ink being exposed to the air before use to darken by the formation of the black tannate of iron. In modern ink this preliminary change due to oxidation is omitted, and a colouring matter, such as indigo, is added to give an immediate coloration so that the writer may see what he is doing. The indigo or an aniline dye immediately provides the blue; the iron-gall ultimately the black. As the iron-gall constituent oxidises gradually, becoming black, the colour changes from the bright blue of the aniline colour to a deep violet which results when the black pigment has formed. This change in colour proceeds fairly rapidly, as common experience shows, in the light, and more gradually in the dark, but in any case is usually complete in the course of a few months. Now if the ink upon a document supposed to be two or three years old be of a bright blue colour, and if chemical analysis prove it to be an iron-gall and not an aniline ink, the fact is suspicious. If, further, the ink subsequent to examination becomes progressively more violet on exposure to light and air, it is almost certain that the document is not so old as it is said to be, for, if it were two years old, the maximum intensity of colour would long before then have been reached. After writing has attained its maximum intensity of colour, a further gradual change due to oxidation takes place, which is not usually complete until after about four years.

It is owing to the use of different pigments for this provisional colouring matter that it is often possible to distinguish between the inks of different manufactures in writing. By treating the writing with dilute acid the iron tannate may be bleached, leaving the aniline dye available for examination. Whether or not provisional colouring matter of an ink is an aniline dye may be of importance. During the last years, entries in family Bibles have been produced in support of claims to a pension, but the presence of an aniline dye in the ink, on more than one occasion, has proved conclusively that the entries were forgeries.

The different proportions of iron and tannin from various sources also contribute to the character of the reaction given in ink by writing. An expert, after a series of systematic tests with his reagents, and using an apparatus called a tintometer to compare the changes in colour of the ink produced by the reagents, can frequently tell one kind of a blue-black ink from another with certainty. The first occasion on which the method was used in an English Court of Law was at the trial of Brinkley in 1907, when it was proved that an alleged will was written in three different kinds of ink.

Judging the approximate age of an ink is generally much more difficult than deciding the identity of two inks. There are certain distinct differences in the microscopical appearance of very old and of modern inks. The latter show a much more crystalline appearance, mainly due to the pigment attached to the fibres of the paper, and it is often possible to see dark margins to the lines due to the greater absorption of pigment at the places where the pressure of the divided pen nib was applied. This is illustrated in Figs. 1 and 2.

It was mentioned above, when the properties of an iron-gall ink were being described, that comparatively new inks are smudged when treated with certain reagents, while older ones either do not smudge or are affected only very slowly. This method of deciding the age of the ink on a document was used by the writer in the case of *Rex v. Pilcher* which was tried in 1910. It was found that the ink in the body of a will, alleged to be eleven years old, and of all the signatures, reacted immediately with several reagents and gave a copious smudging of the blue pigment, while all indications of the black pigment at once disappeared. Its characteristics therefore did not agree with those to be expected of an ink eleven years old. When similar tests were applied to inks upon a series of cheques written by the lady who was alleged to have signed the will, a fairly rapid reaction and smudging was found on cheques two or three years old; much less reaction and smudging on cheques five years old; little reaction and almost no smudging on cheques six years or more old, and no effect at all for a long time on cheques as old as the will was said to be. It was deduced from this that the ink, and therefore the will, could hardly have been six years old. Moreover, the ink of the cheques was the same kind of blue-black ink as that on the will, so that the comparison of their behaviour to reagents was a fair one.

In Fig. 3 the behaviour of writing of 1909 in the presence of dilute acid is compared with that of writing of 1921.

Of course common sense is sometimes a sufficient guide in deciding the authenticity of handwriting. An ancient ink, for example, cannot be genuine if it contains an aniline dye. An interesting case may be quoted from Mr. Lucas's book on *Forensic Chemistry*. A register was presented in Court in support of a case. The dates of the entries extended over more than a year, and it was stated that the register had been kept and entered up in an office. The book, however, was clean and new-looking, and quite free from dirt and dust, the ink was a bluish-green aniline ink, and so could not be dated from chemical evidence, but it was of exactly the same colour throughout, and the writing was in the same hand and was all done with the same or a similar pen, but showed signs of haste or fatigue towards the end. In two instances an entry which belonged to several lines below had been made and afterwards erased, and the dots under a word to indicate repetition, which occurred plentifully on every page, had in some instances been written vertically on a number of different lines at the same time, the ink showing progressively diminishing intensity of colour from the top to the bottom of the page. It is needless to add that the register's genuineness was not established.

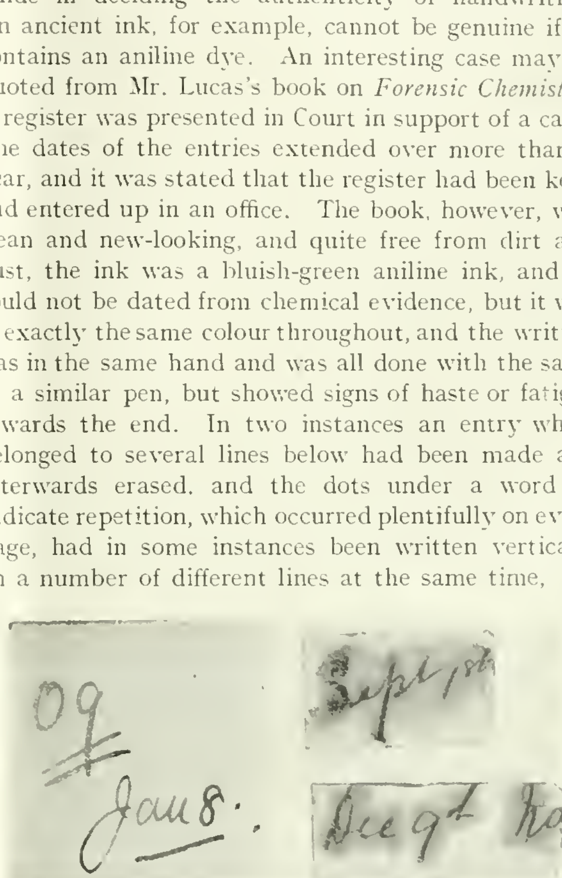

FIG. 3.—EFFECT OF A REAGENT ON BLUE-BLACK IRON-GALL INKS OF THE SAME TYPE IN WRITING OF 1909 AND 1921.

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(An article by the same author on *Pencil Pigments in Writing* will appear in the January number.)

Between the Covers

HEAD-HUNTING IN FORMOSA

In our Editorial Notes for last October we mentioned that "the sudden stopping of head-hunting in the Solomon Islands left so great a gap in the daily interests of the natives that they very speedily lost their virility." The extremely important part which this custom plays in the social organisation of many primitive or semi-primitive races is well illustrated by the following account of its practice amongst the native tribes of Formosa, the island, now governed by the Japanese, which lies off the east coast of China. This account occurs in Mrs. J. R. Montgomery McGovern's newly published book, *Among the Head-hunters of Formosa* (T. Fisher-Unwin, Ltd., 15*s.*): "I think that anyone who has lived among a head-hunting tribe will realise how closely this custom is interwoven with the fabric of their whole social organisation. It regulates the social and political standing of the men of the tribe; it is directly connected with marriage—no head, no wife; and is reflected in the games, the songs, and the dances of the people. Moreover, head-hunting is regulated by a code as rigid as the code of 'an officer and a gentleman' in so-called civilised society—and is rather less frequently broken.

"Deniker, in speaking of the Dyaks of Borneo (see *The Races of Man*, p. 251), aptly remarks: 'A number of acts regarded as culpable by the codes of all civilised states are yet tolerated, and even extolled, in certain particular circumstances; such as the taking of life, for example, in legitimate defence, in a duel, during war, or as a capital punishment. Thus, in recalling examples of this kind, we shall be less severe on a Dyak who cuts off a man's head solely that he may carry this trophy to his bride; for if he did otherwise he would be repulsed by all.' The same charity for which Deniker pleads in judgment of the Dyak may well be extended to the Formosan aborigine, who never thus seeks private vengeance, whatever his provocation, on one of his fellow-tribesmen, private disputes being always laid before the chief—male or female—of the tribe or before the chief priestess, or a convocation of the elderly women of the tribal group. Also when a Formosan has voluntarily given his word to refrain from head-hunting, it is said—and my personal observation would tend to confirm this—that he never breaks it.

"The tribes among whom head-hunting still exists are the Taiyal, the Bunun, and the Paiwan, though among the Bunun and the Paiwan to a lesser extent at the present time than among the Taiyal. Among all the other Chin-huan tribes it existed within the memory of the older generation still living.

"Among the Taiyal tribe—the great tribe of the northern part of the island—one can tell at a glance who has 'a head to his credit,' by the presence, or absence, of the tatto-mark on the chin. Occasionally one sees the insignia of the successful head-hunter tattooed on the chins of young boys. This indicates that these boys are the sons of famous head-hunters and that their hands have been laid upon heads decapitated by their fathers; or that they have carried these heads in net-bags upon their backs. This, by tribal code, entitles them to the successful head-hunter's tattoo-mark. Incidentally, it must be understood that while Taiyal are—largely because of their peculiar form of tattooing—usually regarded as a single tribe, they do not so regard themselves, but are composed of a number of sub-groups (it is said twenty-six), who regard themselves as separate units, and who consequently go on head-hunting expeditions against each other.

"When a boy attains maturity he is supposed to celebrate this by going on his first head-hunting expedition. Usually several boys of about the same age go together on their first expedition, accompanied by older and more experienced warriors of the same group or sub-tribe. Before going on such an expedition an omen is always consulted—usually a bird-omen—and it depends upon the favourable or unfavourable indication of the omen as to whether the expedition is undertaken forthwith or is postponed. The Taiyal consider it more auspicious to set forth on such an expedition with an odd number of men. They seem to think the chances will be greater of securing a head, which will count as a man, and thus make up the 'lucky even number' with which they hope to return to the village."

THE HARNESSING OF THE JORDAN

In view of the recent Rutenberg controversy in the House of Commons, the following extract from an article by Henry Woodward Hulbert on *Irrigation and Water-power in Palestine*, which appeared in the November number of our excellent contemporary the *Scientific American* (Munn & Co., New York, 35 cents), is of considerable interest:

"For many years the water-power possibilities of the vast depression of the Jordan Valley in Palestine have been evident to all engineering observers, and especially since Lieutenant Kitchener (later Viscount) completed the survey of Western Palestine for the Palestine Exploration Fund. That strange river rises but a few hundred feet above the level of the Mediterranean and soon is checked in its course by the extensive morass of the Huleh Basin. As this can never be drained successfully, it furnished the first opportunity for an extensive barrage, below which is a drop of 700 feet

within a 10-mile course to the Sea of Galilee. At this point it is certain that many hundreds of thousands of horse-power can be generated.

"The second power-house in the system would be constructed at the outlet of the Sea of Galilee, where a barrage can be thrown across the Jordan as it issues from that huge basin. This would hold the waters of that sea at least at high-water mark. Possibly it may be found that the level could be brought two or three feet higher without serious damage to the shore privileges. Here again many hundred of thousands of horse-power could be generated.

"In the 60 miles (as the crow flies) from Galilee to the Dead Sea the drop is about 600 feet. The waters of the Jordan may well be diverted at this point from the winding channel and carried down by canals on either side of the valley at proper levels for irrigation purposes. There is no richer or more neglected land in the world than would thus be opened for cultivation. A considerable body of this water must be carried 30, 40, or even 50 miles for use in the lower valley and can be used at every drop to generate more electricity.

"Three considerable perennial streams flow into the Jordan and the Dead Sea from the east below Galilee, the Yarmuk (Hieromax), the Zerka (Jabbok), and the Arnon. Here again large irrigation opportunities present themselves and incidentally water-power privileges. The first two of these and other smaller streams from east and west should be led into the two canals carried down the sides of the Jordan Ghor at high levels. Possibly a total of a dozen barrages across the mouths of wadies coming down into the valley could impound all extra fresh waters and receive the spill-over from the canals during the rainy season (November to April). The plan would be to use up entirely the fresh water of the Jordan system, so that eventually none of it shall flow into the Dead Sea. By the power generated, water could be pumped to reservoirs at high levels on either side of the Jordan Valley, thus greatly extending the irrigation of rich soils never yet brought under continuous cultivation.

"In all this we have only the ordinary scientific handling of a river system for highest agricultural and water-power purposes. But in discussing the Jordan Valley we have the absolutely unique situation of a river rising but a little above sea level and spending its complete course in descending ('Jordan' means 'the descender') to the depth of 1,300 feet below the sea level. At one point this strange depression approaches the inexhaustible reservoir of the Mediterranean within 25 miles, five of which lead through the rich alluvial plain of Acre to the foothills of Galilee, leaving only 20 miles of tunnelling through soft limestone to the Jordan watershed, whence the waters of the Mediterranean can be carried down the 1,300-foot descent to the Dead Sea through a straightened river-bed by a system of barrages by which to extract from the descending mass of waters the last degree of horse-power possible.

"When, some years ago, the experiment was broached of letting the Mediterranean waters into the Jordan depression by a canal via the Kishon Valley and filling up the whole valley of the Jordan and then cutting through the intervening barrier from this inland sea to the eastern upper prong of the Red Sea for ship canal purposes, paralleling the Suez Canal, the whole project, after careful investigation, was given up. The engineers, granting that levels and cuttings were quite practicable, brought in the verdict that, so great was the evaporation in the deep Ghor of the Jordan Basin, no plan could be devised that would let in water fast enough to fill it up. This being the case it is clear that the Mediterranean water can be thus turned into this deep depression up to the limit of its evaporating possibilities. This can only be determined by experiment, but there cannot be any doubt that the amount of electrical fluid thus to be generated would surpass many times over the total capacity of the Niagara tunnels."

THE DROUGHT OF 1921

"Considering the year as a whole, it is seen at once that 1921 was, in certain areas, a year of unprecedentedly small rainfall. Sufficient data exist to construct maps showing the percentage of the average rainfall occurring in the British Isles in each year back to about 1850. Since then there is no doubt that the only years which are in any way comparable with 1921 were 1854, 1864, 1870, and 1887. The last-mentioned was by far the driest year hitherto known to have occurred in the British Isles. The year 1858 was also dry, especially in England and Wales, but not quite as dry as any of the other years mentioned."

Records of more than 75 years' duration indicate that "for London 1921 was the driest year for at least 148 years, and as London was by no means the driest district relative to the average, it may be justifiably inferred that in 1921 a considerable part of the south-east of England had the least rainfall for at least a century and a half, and probably for a still longer period, though complete statistical proof is wanting."—From *The Drought of* 1921. (From *Quarterly Journal of the Royal Meteorological Society*, vol. xlviii.) By C. E. P. Brooks, M.Sc., and J. Glasspoole, B.Sc., A.I.C.

THE PROVINCE OF DARFUR

In *The Geographical Journal* (2s.) for November an interesting account is given of the modern history

of Darfur (Western Sudan) by Mr. E. G. Sarsfield-Hall, B.L., LL.B., of the Sudan Civil Service. The author writes:

"Darfur, or the country of the Furs, was formerly one of a chain of ancient kingdoms which stretched across the African continent from east to west, and of which Abyssinia alone survives to-day as an independent state. Its original inhabitants were a Negro race, who lived a primitive existence in the more mountainous parts of the country, and were ruled by a line of pagan Dagu sultans. In the sixteenth century, however, they were brought into touch with Mohammedan influence, and thereafter gradually converted to Islam. With their conversion, the sultanate passed into the hands of the arabicised Kungara branch of the Fur, and in 1596 Solong, the first Mohammedan sultan of Darfur, whose mother was an Arab, ascended the throne.

"The old Dagu sultans had been content to rule a circumscribed area surrounding their mountain fastnesses, but their successors had more ambitious ideas and soon set about extending their dominion. Descending from the great Marra range, they not only conquered the wide plains adjoining it, but also overran the neighbouring province of Kordofan, and finally penetrated victoriously as far as the Nile. Their triumph was, however, short-lived, and the warlike Fungs soon commenced to drive them westwards whence they had come. By 1770 they had lost even the province of Kordofan, and, though they retook it a few years later, it was finally conquered from them in 1822 by Mohammed Bey Daftardar on behalf of the Egyptian Government.

"After this reverse the Darfurians retired westwards, but fifty-two years later Darfur itself was annexed to Egypt by the famous Zubeir Pasha, who advanced into it from the south on the pretext that the Darfur sultan was unable to control his people and prevent them raiding into the Bahr-el-Ghazal. In 1877 General Gordon visited Darfur, where Sultan Harun was in revolt, and Suliman, the son of Zubeir Pasha, was carrying out extensive slave raids at the head of a large body of well-armed followers. He succeeded, to a certain extent, in restoring the confidence of the Government troops and in pacifying the country, but was compelled to return to Khartoum, leaving Sultan Harun still at large and Suliman but temporarily submissive.

"The Fur sultans hotly resented the annexation of their country by the Egyptians, to whom they refused submission, and against whom they carried on a desultory warfare from their strongholds in Jebel Marra. Whenever a sultan was slain another arose in his place, with the result that the Egyptians never succeeded in completely pacifying the country. In 1882 the Mahdists overran Darfur, and two years later their representative, the Amir Mohammed Khalid (Zogal), succeeded in capturing Abdullahi Dud Banga, the last of the sultans to defy the Egyptian Government. Peace reigned until Mohammed Khalid, being summoned by the Khalifa to Omdurman appointed Yusef, the son of the late Sultan Ibrahim Garad, to rule Darfur during his absence. No sooner was his back turned than Yusef raised the standard of revolt, and though he himself was killed in 1888, a small but resolute band of Furs continued to defy the Khalifa's authority. In 1896, however, Ali Dinar, the last of the rebel sultans, finding himself deserted by the greater part of his followers, surrendered to the Dervish Amir Abd el Gadir Wad Dalil. He was sent to Omdurman, and remained there until the eve of the battle of Omdurman, when he fled westwards, intending to seize the throne of Darfur. One Ibrahim Ali, a nephew of the late Sultan Yusef, had already been dispatched to Fasher by Sir Herbert Kitchener with instructions to take over the administration of Darfur on behalf of the Government. Ali Dinar, however, reached Darfur before him, and lost no time in disposing of the Dervish Amir in charge of the province, of another rival claimant to the throne whom he mockingly appointed sultan of the despised blacksmiths, and finally of Ibrahim Ali himself.

"A short time later, having securely installed himself, he acknowledged the suzerainty of the Sudan Government, and in 1900 was appointed Governor-General of Darfur, subject to the payment of a nominal tribute of L.E.500 per annum. This tribute was regularly paid until after the outbreak of the European War in 1914, when Ali Dinar cast off his allegiance and refused to make any further payments. He had, as he well knew, chosen an embarrassing time to declare his independence. Turkey had just entered the war, and the Sultan of Turkey, as Khalif of Islam, had called his co-religionists to a world-wide jehad.

"Undesirous of provoking an armed conflict, the Sudan Government used every endeavour to bring the recalcitrant sultan to reason. But Ali Dinar turned a deaf ear to all counsels, and it soon became apparent that nothing but the occupation of his country would reduce him to submission.

"When the revolt was crushed the Sudan Government was faced, in the midst of the embarrassments of the European War, with the problem of bringing a newly acquired country, approximately 160,000 square miles in area, under administrative control. The whole country lies between 2,000 and 3,000 feet above sea-level, and down the centre of it zigzags a chain of rocky hills, sometimes assuming the proportion of mountains, which form the watershed of the country and part of the great watershed separating the Nile

from the basin of Lake Chad. The geological formation of these hills is varied, and has not yet been subjected to expert examination. The Jebel Meidob group appears to contain both sandstone and granite, but has been much distorted by volcanic action. Many of the hills comprising it are the craters of extinct volcanoes, and much of the country immediately surrounding it is littered with calcined rock and lava. It consists for the most part of a conglomeration of low tangled hills, but the highest peak in the central range rises to a height of about 1,200 feet above the plain."

But the difficulties which the Sudan Government had to surmount were not only geographical. They had to deal with a conglomeration of races, the main elements in which were: "(1) The Arabs; (2) the Tibbu or northern Negroid peoples; (3) the sedentary, indigenous races; (4) the immigrants from the west; (5) the immigrants from the north."

Order was eventually restored by a mobile column under the command of Lieutenant-Colonel T. B. Vandeleur (Royal Irish Regiment), which left Fasher for northern Darfur on December 18, 1916. The writer accompanied it as Political and Intelligence Officer. Early in 1917 various district headquarters and police posts were established throughout the province, and the "veritable orgy of raiding and lawlessness" carried on by the Zaghawa of northern Darfur, a "wild, dark, quarrelsome, thieving people," under the leadership of Mohammed Erbeimi, was put an end to.

The province is "well suited for stock-raising," while "excellent crops are grown in southern Darfur," and, though a geological survey has not yet been made, mineral deposits, especially as regards iron, copper, and lead, are fairly extensive.

SCIENCE AND CIVILISATION

"It is emphatically the promise of the application of science to the whole of life which is the finest feature of our age; it is the delay in fulfilling that promise which leaves our civilisation so crude and elementary. We apply science to the metals and chemicals of the soldier, even to the brains of his generals; but when it comes to studying the human conditions out of which wars arise, we leave the job to a group of utterly unscientific statesmen and diplomatists, who will consider a hundred things except what ought chiefly to be considered. We apply science to industry, and it invents machines for us which are as far beyond any mechanism known in Babylon or Athens as the Athenian loom was beyond the flint scraper of prehistoric man; but we will *not* apply science to the very greatest and gravest of all industrial problems—whether it is really necessary to keep the greater part of the race in a state of poverty and imperfect mental development and let a few monopolise its art and culture. We apply science with brilliant success to discover the evolution of mind or the evolution of morals; but we do not consult it at all when we confront the very imperfect moral condition of the world, the poor general level of character from age to age, and the chaos of contradictory opinions which is responsible.

"The old Greeks were right. The first virtue is wisdom. The uplifting of our race demands the cultivation of the heart—of fine sentiment and character—just as much as the cultivation of the mind, but the latter is more fundamental. We must know the right way before we can walk in it. That is the truth we are re-discovering. We are beginning to apply science to life. We have done with *laissez-faire*—which means, let things grow up. We are going to make them grow up. We have so bred and trained cows that they will give three thousand gallons of milk a year. There is not an element or feature of life that we cannot similarly raise to a vastly higher level. We are going to treat life as a scientific breeder treats plants. It shall all be plotted out, and its conditions scientifically studied, by a central brain. The idea of fighting it out and letting the better survive is the very opposite of science. Evolution guided by intelligence, constructive evolution, harmonious social co-operation—these are the ideals obviously thrust upon us by the very fact that intelligence now exists.

"And it is an essential condition of this further and more rapid progress that a way shall be found of putting an end to the old division of the race into a cultivated few and an uncultivated many. Democracy is inconsistent with such a situation, and is always in danger of being wrecked by it. Fine sentiment is inconsistent with it. The time is coming when men of brain will themselves devise a way out, for our age is now rapidly advancing in sentiment as well as in intelligence. When these conditions—the general and concentrated application of science to life and the elevation of the mass of the people until they can demand and watch it—are realised, the race will move on at an amazing pace. I am optimistic enough to believe that this new era, new sort of evolution, will begin in the twentieth century. And before the race lie *millions* of years during which this planet will be habitable.

"In fine, a word to the croakers who say that science may work out definite tasks, but it assigns no general goal to life. The fact is that you need no science whatever to answer that foolish question: What is the end of life? It is whatever we men may choose

to make it; and since we live in social groups, and a man's actions depend upon and influence his neighbours, it is what we choose to make it *collectively*. There is no doubt to-day about our choice. We are going to develop what is most clearly worth developing in us: intelligence, refinement, character, health. We are going to eliminate pain, unhappiness, ignorance, coarseness, violence, and poverty, as far as possible. We are going to have a hundred commonwealths, ten thousand cities, competing with each other in the realisation of this ideal. So, when the war drums beat no longer and the strong have ceased to exploit the weak, the fundamental condition of progress, mutual stimulation, will be provided on a higher plane, and the close interconnection of the whole world will make it more effective than ever."—Joseph McCabe in his book on *The Evolution of Civilisation*. (Watts & Co., 2s.)

Broadcasting by Directional Wireless[1]

By Lt.-Col. C. G. Chetwode Crawley, R.M.A., M.I.E.E.

Deputy Inspector of Wireless Telegraphy in the General Post Office

Now that the broadcasting arrangements are practically completed, it is useful to consider along what lines we may hope for future developments.

The arrangements being made, it will be remembered, provide for eight broadcasting centres in Great Britain, as it was considered that more than eight would lead to mutual interference, at any rate in the earlier stages of the experiment. This shows incidentally how very far removed we still are from the possibility of having a general scheme of wireless telephony in any way comparable to a system of line telephony. The very fact, indeed, of wireless telephony being so suitable for broadcasting means that it is unlikely that it can ever be very suitable for point-to-point communications, unless it be possible to arrange for directive working.

As a matter of fact, within the last few years great strides have been made in the technical details of this directive working, that is, in arranging for the wireless waves to be radiated, not in all directions, but as a beam like a searchlight, and for the receiving station to be affected by waves, not from all directions, but from a desired direction only. At receiving stations such arrangements have been available, when desired, for some years, but they are too expensive and complicated to be at all suitable for use by the general public. If such arrangements *were* available for receiving stations in the broadcasting scheme, the number of transmitting stations could be increased, and the listener would be able to hear any broadcasting station, which is within range, without fear of interruption. He could then choose to listen to whatever station was transmitting the sort of matter which he wanted to hear, instead of, as now, being compelled to listen to, say, Mr. Robey's latest song when he was really itching to hear Mr. Bonar Law's latest speech.

However that may be, the fact remains that apparatus for directive reception has not yet reached the stage where it can be installed without considerable expense, or manipulated without expert knowledge, but as time goes on so will these difficulties diminish, and it is easy to foresee great possibilities for broadcasting by wireless to listeners fitted with directive receivers.

In the case of directive transmission, the technical difficulties have proved to be much greater than in directive reception. Within the last year or two, however, it has been found possible to fit, at small stations, apparatus for transmitting messages in any required direction in, as it were, a wireless beam. This arrangement, when developed, will certainly be most useful for navigational purposes, as ships, or even aircraft, will be able to locate their positions by observing when they come within the beams of specified coast stations. A system of these wireless stations will, in fact, become a most useful adjunct to the present lighthouse system for navigational work near the coasts.

But so far as broadcasting is concerned, there seems little scope for directional transmission, as, after all, the chief object of a broadcasting station is to send messages, without interference from or with other stations, to as many receivers as possible, and this can best be done by using directional apparatus at the receiving end only.

[1] For a full account of "Directional Wireless," the reader is referred to an article by the same author in DISCOVERY, Vol. III, No. 26.

Some Children's Games and Songs in Ancient Greece

By W. R. Halliday, B.A., B.Litt.

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MOST of us at one time or another have played the uncomfortable rôle of the Complaisant Man who, Theophrastus tells us, "when asked to dinner will request the host to send for the children, and will say of them when they come in, that they are as like

their father as figs; and will draw them towards him and kiss them and establish them at his side—playing with some of them, and himself saying: 'Wineskin, Hatchet,' and permitting them to go to sleep upon him to his anguish."[1] How *Wineskin and Hatchet* was played I do not think is known. With some games we are more fortunate. A kind of *Prisoner's Base*, which was called *Night and Day* from the names given to the two sides, is alluded to by Plato. In this a piece of pottery, black upon the one side and white upon the other, was tossed up. If white came down uppermost, Day were the catchers and Night had to get "home" before being caught. Plato, again, compares the earth to a kind of ball, the cover of which was made of twelve different-coloured pieces of leather, and a variety of ball games are described by Pollux, who gives us also the ancient Greek varieties of *Tug-of-War, Hide and Seek*, and *Blind Man's Buff*. Why the latter got the name of *Brazen Fly* I do not know. A child was blindfolded and turned round. He then recited, "I'm going to hunt a brazen fly," while the others beat the blindfolded "it" with strips of leather, shouting, "You will hunt but you will not catch."

The boys of Tarentum played *I Bring out the Lame Goat*, but we know only the first line of the song. The girls' game *Cheli Chelone* we may perhaps call *Torty Tortoise*; the first word seems to be a mere nonsense reduplication of the sound of the first syllable of *chelone*. Liddell and Scott rather strangely describe it as a kind of *Hunt the Slipper*. Pollux says, "it is rather like *The Pot*."[2] One girl sits down and is called the Tortoise, while the others dance round her singing:

> "Torty Tortoise, what are you doing in the middle?"
> "I am weaving wool and Milesian cloth."
> "But what was your child doing, when he was lost?"
> "He jumped from his white horses into the sea."

I imagine that the last line was the prelude to some action by which a child was caught, and that *Torty Tortoise* belongs to the same genus as *Mother Mother the Pot Boils Over, Gipsy*, and *Old Cranny Crow*.

Milesian woollen cloth was the best in Greece, and upon its export the material prosperity of Miletus largely depended. This explains the close friendship between Miletus and Sybaris in South Italy. When Sybaris was destroyed by her rival and neighbour Croton in 510 B.C., the Milesians went into mourning. Their grief is intelligible enough when we remember that Sybaris was the depot for the Milesian trade in the Western Mediterranean. The woollen goods were landed at Sybaris, transported by land across the toe of Italy, and thence reshipped to Etruria and the markets of the West.

A singing game called *Posies* is mentioned by Athenæus. It clearly resembles *Nuts in May* and possibly *My Delight's in Tansies*, but I am not certain how the latter is played. The following verses are quoted:

> "Where are my roses, where are my violets, where is my beautiful parsley?
> These are my roses, these are my violets, and this is my beautiful parsley."

Why, asks Plutarch in his Greek Questions, was there a custom amongst the Bottiæan maidens, as they danced, to sing, "Let us go to Athens"? He answers his conundrum by reference to mythological history. Bottiæa was founded by Cretans in prehistoric times, and with the Cretan settlers came Athenians. For Athens, until Theseus slew the Minotaur, paid a yearly tribute of men and maidens to Minos, King of Crete, but these were not all given to the Minotaur, and some of the survivors took part in the Cretan colonisation of Bottiæa. Hence it is in memory of their Athenian origin that this popular song is sung. Some scholars have taken Plutarch seriously, but I do not myself believe that this yarn is earlier than the fifth century B.C., when Athens was bringing the Northern Ægean under her influence. Readers of Herodotus will be familiar with many other examples of the invention of legendary connections in prehistoric times in order to justify the pretensions of Athenian imperialism. It may quite well be that the Theseus story came into the game, for a singing game I think it pretty obviously is. We may compare—

> "Lend me a pin to stick in my thumb,
> To carry the lady to London town"—

which is played as far from London as Fifeshire; or the common English game—

> "How many miles to Babylon?
> Three-score and ten.
> Will we be there by candle-light?
> Yes, and back again.
> Open your gates and let us go through.
> Not without a beck and a boo.
> There's a beck and there's a boo
> Open your gates and let us go through."

In the second Messenian War at the end of the seventh century B.C., Aristomenes was the heroic leader of the rebels against Spartan rule. "When Aristomenes returned to Andania the women threw ribbons and fresh flowers on him and recited in his

[1] *The Characters of Theophrastus*, translated by Jobb.

[2] *The Pot* was a boys' game. One boy in the centre held a pot on his head with his left hand, the others ran round him shouting, "Who holds the pot?"; the answer to which was "I, Midas." Whoever "Midas" succeeded in touching with his foot, took his place in the centre.

honour a song, which is sung to this day (our informant Pausanias is writing in the second century after Christ):

> "To the midst of the Stenyclerian plain and to the top of the mountain
> Aristomenes followed the Lacedæmonians."

We are reminded of 1 Samuel xviii. 7,[1] and the song may have been a popular ballad, but again I suspect a singing game. Historical events often leave their traces in nursery song. A Shropshire woman in the nineteenth century was heard to hush her baby with:

> "Ring-a-ding, I heard a bird sing
> The Parliament soldiers are gone for the king"—

which is a clear reference to General Monk's mission in 1660.

Where our children sing, "Rain, rain, go to Spain, Fine weather, come again," the Greek children of

THE COMING OF SPRING.

Aristophanes' day clapped their hands and sang, "Come out, dear Sun." With—

> "Lady-bird, lady-bird, fly away home,
> Your house is on fire, your children all gone"—

may be compared, "Fly, beetles; a savage wolf is after you."

Greek children had also a song to "send away the strix, the crier by night, from the land, the nameless bird, upon the swift ships." The strix was a vampire-witch who affected the shape of a screech owl and was peculiarly addicted to sucking the blood of small children.

At weddings a song was sung about crows. There is, unfortunately, considerable doubt about the text. The reading, "Boy, drive away the crow,"[2] has been interpreted by the theory that the crow symbolises widowhood. But the crow was a bird of ill luck, and naturally its appearance at weddings would not be welcomed. I suspect that the song was merely the equivalent of the English—

> "Crow, crow, get out of my sight,
> Or else I'll eat your liver and light";

or the French—

> "Corbeau, corbeau sauve toi
> Voila le petit-fils du roi,
> Qui te coupera al p'tit doigt!
> Vinn vinaigre!"

The most famous of Greek seasonal songs is the *Swallow Song* of Rhodes. In ancient Greece as in Europe pretty generally the advent of the swallow marked the beginning of spring. In the illustration

[1] "And the women sang one to another in their play and said:
"'Saul hath slain his thousands
And David his ten thousands.'"

[2] The first line of the song has been corrupted, from causes readily intelligible, into the jingle ἐκκορὶ κορὶ κορώνην. Bergk's reading, ἐκκόρει, κόρη κορώνη, "Sing the marriage song, maiden crow," gives an ill-supported meaning to the verb, and explains the "maiden crow" by a suggestion for which there is some evidence that girls were sometimes nick-named crows. But ἐκκόρει, κόρε, κορώνην preserves the normal sense of the verb and is quite straightforward. Although our authorities refer to its use at weddings, I doubt if the song was necessarily restricted to those occasions.

taken from a black-figured vase the seated figure on the left is saying, " Look, a swallow." " By Heracles, so there is," says the man in the middle. " There she goes," says the third. " It is spring already." When the swallow came, the thick clothes of winter were put off and summer suits were donned. The swallow song, then, was a spring song performed by bands of boys who went from house to house making a collection.

" She has come, the swallow has come, bringing fine seasons and fine years, white on her belly, black on her back. Roll out a cake of compressed fruit from your rich house and a cup of wine and a basket of cheese. Wheaten cakes too, and bread of pulse the swallow does not reject. Are we to go or are we to get something ? If you give something, well, but if not we will not go away. Either we will carry off the door or the lintel or your wife who sits within ; she is small and we shall easily carry her off. And if you bring anything, bring something big. Open the door to the swallow ; for we are not old men but boys." In some parts of Greece the swallow song is still performed on March 1st by boys carrying a wooden swallow on a pole. In the British Isles we may compare the *Wren Song* of Christmastide :

" The wren, the wren, the king of the birds,
St. Stephen's Day was caught in the furze ;
Although he is little, his family's great.
I pray you, good landlady, give us a treat.

" My box, it would speak, if it had but a tongue,
And two or three shillings would do it no wrong.
Sing holly, sing ivy—sing ivy, sing holly,
A drop just to drink it would save melancholy.

" And if you draw it of the best
I hope your soul in Heaven may rest.
But if you draw it of the small
It won't agree with the wren-boys at all."

The Lesbian mill song is perhaps rather a genuine work-song than a singing game—

" Grind, mill, grind,
For Pittacus too grinds,
Who is king in great Mitylene."

An interesting parallel has been recorded by the late Professor Politis. A woman in Maina, the wildest part of the Peloponnese, upon whom there were billeted the police who were after her husband, who had taken to the hills, was heard to sing :

" Grind, mill, grind,
Turn out your flour fine,
Your wheaten flour crisp
That the policemen may eat,
And the sergeant, the dog,
Who is sitting in the corner." [1]

[1] Quoted Kyriakidis, *Αἱ γυναῖκες εἰς τὴν Λαογραφίαν*, p. 68.

Pittacus was a friend of Alcæus the poet, and with him a conspirator against the tyrant Myrsilus, but eventually became tyrant himself early in the sixth century B.C. His name, like that of Periander, tyrant of Corinth, was included in the list of the traditional Seven Wise Men of Greece. It is recorded of him by Diogenes Laertius that a friend came and asked him whether it was wiser to marry an aristocratic bride or one from his own station. " Go after those boys who are whipping their tops," said Pittacus, " and listen to what they say." When he got near, the friend heard one boy say to the other, " Whip the one that is by you."

To pursue the practice of divination from the chance utterances of children at play would take us too far afield. It is not uncommon. Plutarch tells us that the Egyptians drew inferences from the chance utterances of children playing in the temples ; the hearing of a boy's voice, which repeated, " Take up and read," was a factor in the conversion of St. Augustine ; the deductions to be drawn from children's play are given in a German pamphlet of popular divination belonging to the sixteenth century, and an interesting account drawn from an eyewitness, the author's grandfather, is given by the Turkish traveller Evliyá Efendi, of how the play of the seven sons of Sultan Ahmed I (1603–1617) foretold their respective destinies and the conquest of Crete by Sultan Ibrahim.[2]

The text of the Greek songs will be found collected in Bergk, *Poetæ Lyrici Græci*, vol. iii, and a description of the English games mentioned in Lady Gomme, *The Traditional Games of England, Scotland, and Ireland* ; some of the explanations of their origins there given may perhaps be taken with a grain of salt. For the bird songs see Swainson, *The Folklore of British Birds*. The text of modern Greek swallow songs is given in Passow, *Carmina Popularia Græciæ Recentioris*, Nos. 305–9. The illustration is after Baumeister, *Denkmäler, des Alterthums*, III, Fig. 2128 ; it is also figured in Miss Harrison, *Themis*, p. 98. The current number of the *Journal of Hellenic Studies*, vol. xlii, contains reproductions of the very interesting reliefs of the sixth century B.C. which were discovered in Athens this year. One of the scenes depicted can only be described as a game of hockey !

THE ANTIQUITY OF MAN IN AMERICA

In the articles on " The Antiquity of Man in America " which appeared in our October and November numbers, the author, referring to the discovery of a tooth in the early Pliocene beds of Nebraska, impressed upon his readers the necessity for caution and careful deliberation before accepting the identification of this tooth as the molar of an ape-like man of a type earlier than any hitherto discovered. It is, therefore, interesting to note that this identification was called into question at a meeting of the Zoological Society of London held on November 7, when photographs and a cast of the tooth were exhibited by Prof. Elliot Smith. After a careful examination of the characters of the tooth, one by one, and of the pulp

[*Continued at foot of page 330.*

[2] Von Hammer, *The Travels of Evliyá Efendi II*, pp. 85–8.

The Movements of the Planets

By H. Spencer Toy, B.Sc., A.Inst.P., F.R.A.S.

The whole system of the stars appears to move across the sky from east to west every twenty-four hours. This is due to the rotation of the earth on its axis once a day. Of this motion we need not think in this article, since the sky seems to move as a whole.

The sun and moon have a second motion that is easily observed, for they move among the stars from west to east. Thus, for instance, if the moon is near the Pleiades one night, it will be some distance from them on the next.

Both solar and lunar motions are continuous towards the east. But the planets move among the stars in no such simple way, although on the whole

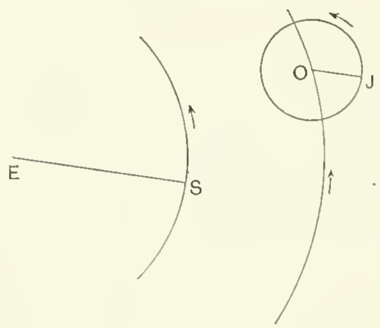

Fig. 1.

they also appear to travel towards the east. It will be convenient to consider them in two groups: those that lie beyond the orbit of the earth, and those that are within.

By those beyond the orbit of the earth we mean Mars, Jupiter, and Saturn, for Uranus and Neptune are not visible to the naked eye. Their apparent motion can roughly be described as a progression in loops. For the greater part of the time they move from west to east, just as do the moon and the sun; then they stop altogether at a so-called "stationary point," move backwards or "retrograde," become stationary again, and then advance towards the next loop.

The loop takes several weeks to make, and can be followed in the sky by comparing the positions of the planet night by night with those of the fixed stars. It is easy to follow this changing configuration when it takes place in a conspicuous constellation, such as Taurus, but it is not very difficult even when it occurs in a barren one, like Cancer. This year Jupiter, for example, made its loop in Virgo, and was therefore very easily followed. Whilst there are many celestial phenomena that most people can never hope to see, among which may be included a total eclipse of the sun, from the town in which they live, and a transit of Venus, this looping the loop occurs so frequently and is so obvious that it may be seen by all. Yet it is improbable that one person in ten, or even one in fifty, ever sees it! It excites no attention in the Press, it gives rise to no great sensation as might a comet or a shower of meteors, and the loops are made unnoticed.

Jupiter traces out a loop once in every 399 days, a trifle over thirteen months, and eleven loops are made as it revolves completely round the circle of the sky in nearly twelve years. In twelve years' time, therefore, Jupiter will again be looping its loop in or near Virgo. Saturn makes a smaller loop once in 378 days, a year and a fortnight, and completes twenty-eight of them in its journey round the heavens. The loops of Mars are much bigger than either of those already mentioned, but occur less frequently, only once in 780 days, nearly two years and two months. This planet retrogrades for 70 of the 780 days, the corresponding period in the case of Jupiter being 123 days, and in the case of Saturn 137 days.

This loop-like movement was observed from prehistoric times, and its explanation exercised the ingenuity of all the ancient astronomers. They started with two fundamental assumptions, both of which were incorrect. The first was that the earth was fixed in space, and was the centre of the universe; round it the stars revolved. The second was that the circle was the perfect figure, just as seven was the perfect number, and that the planets, being celestial bodies, could therefore move only in circles. With these ideas as his foundation, Ptolemy elaborated a system to explain the movements of the planets, and a very ingenious one it was. It was constructed at Alexandria about A.D. 140, and set out in the famous *Almagest*, which remained for fourteen hundred years the standard work on astronomy. Reference was made to it whenever a dispute arose, and by it all questions about the stars were settled, just as all questions on religion were settled by reference to the Koran.

Ptolemy imagined the sun to revolve round the earth in a simple circle once a year. The planets, on the other hand, revolved round a small circle, which itself went round the earth. In the diagram (Fig. 1), let E represent the earth, S the sun, and J an outer planet, say Jupiter. Jupiter was supposed to revolve round the small circle, centre O, and O itself to go round the earth in the period of twelve years, which has already been explained to be that which Jupiter takes to make the circle of the skies. The small

circle with centre O was named an "epicycle," and the bigger circle upon which O travelled was known as the "deferent." It was further laid down that the line joining O and J must rotate at such a speed

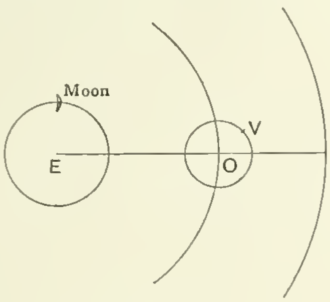

Fig. 2.

as to remain always parallel to the line joining E and S, so that J went round O once every time that S went round E, that is, once a year. It is evident that such an arrangement will give rise to the loop-like motion, the forward movement being obtained when J is outside the deferent, the backward when it is inside.

This explanation holds for Mars, Jupiter, and Saturn, which the ancients regarded as being outside the orbit of the sun. The case of Mercury and Venus, however, is somewhat different. These bodies were recognised to lie between the earth and the sun, and to explain the observed fact that they were never seen very far from the latter, never, for instance, being in opposition, Ptolemy said that the line OV need not be parallel to ES—the condition laid down in the case of the outer planets—but that, instead of it, the centre of the Venusian epicycle, O, must always lie on the line ES (see Fig. 2). Precisely the same explanation applied to Mercury, and the Ptolemaic system is completed when we add that the moon was supposed to revolve round the stationary earth in a simple circle.

The origination and building up of such a system was a veritable triumph of the human mind. Ptolemy's scheme, indeed, was far more ingenious and complex than the simple arrangement of Nature. This is not infrequently the case with human hypotheses, for Nature is at once immensely great and intensely simple. In the early days of astronomy the Ptolemaic explanation of the movements of the planets fitted very well with what could be observed and with the measurements that had been made. But as time went on and observation became more accurate, slight irregularities were noticed that could not be explained by the epicycle rotation. The original theory was therefore modified; it was stated that the earth was not quite at the centre of the concentric circles, nor was O quite at the centre of the epicycle. Thus the circles were now eccentric, and the movements were eccentric, precisely the same kind of thing as may be seen in that part of an engine to which we give the name "eccentric." The Ptolemaic system, thus adjusted, accounted for what could then be measured, but observations were always becoming more exact and further irregularities were always being detected. To meet these new difficulties, the Arabian astronomers introduced new epicycles, and superposed them on the old ones, and kept on adding more and more until the system became exceedingly complicated and absolutely out of harmony with the fundamental simplicity of Nature.

A humorous story is told of King Alphonso of Spain in this connection. He had given orders that tables should be compiled to show the motions of the planets. When the astronomers had finished their work and had taken the tables to the King, they looked so very complex that the monarch is reported to have said, "I wish I had been present at the Creation, I would have given some good advice."

A great change came over the spirit of science with the Renaissance at the beginning of the sixteenth century, and a corresponding change was seen in its statements and results. The ideas of Ptolemy that had flourished so long were rejected altogether by Copernicus, who showed that the complicated explanation involving epicycles and deferents was quite unnecessary, and that for it there could be substituted

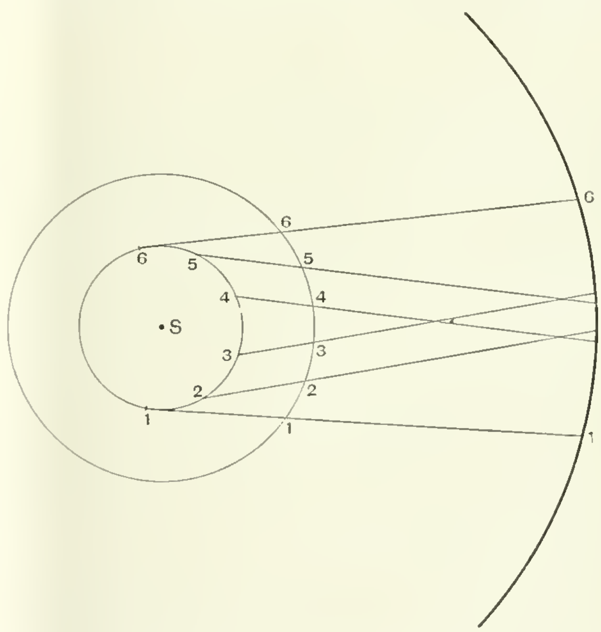

Fig. 3.

a much simpler one, if it were assumed that the planets went round the sun and that the earth rotated on its axis once a day. These two assumptions completely revolutionised astronomy and laid the

foundations for the great modern advances. Yet even Copernicus was not entirely free from the influence of ancient superstition. He kept the perfect curve, the circle, for his planetary orbits, but he stated that the sun was displaced very slightly from the centre; he also accounted for a few irregularities by retaining one or two epicycles. With the exception of these minor points, however, the Copernican system was much the same as the one we now adopt. Kepler completed the work of his great predecessor some sixty-five years later by showing that the paths of the planets are ellipses, but ellipses that do not depart very greatly from the circular form.

Let us now pass on to consider how the loops in the planetary paths can be explained. Suppose the inmost circle represents the orbit of the earth (Fig. 3), and the next one that of one of the outer planets, say Mars. Let the outer circle, shown in part, represent

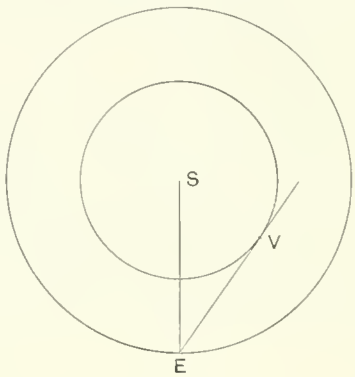

Fig. 4.

the background of the sky, and let S be the sun. At equal intervals of time the earth will be at points marked 1, 2, 3, 4, 5, 6, spaced out equally on its path. At the same time Mars will be at corresponding points on its orbit, marked 1 to 6 on the larger circle. When the earth and Mars are at their points 1, Mars will appear to us to be at the corresponding point 1 on the sky-circle. Similarly for all the other points. The diagram shows us that we get a forward movement from 1 to 3, followed by a backward from 3 to 4, and then a forward from 4 to 6, and onwards until the next loop is commenced. If we imagine the circles as lying slightly out of the plane of the paper, and inclined to it at different angles, the path traced out becomes a loop.

The outer planets always appear brightest when they are in the middle of the backward portion of the loop, for then they are always in a line with the earth and the sun, or exactly opposite the sun as seen by us—a configuration to which we give the technical name "opposition." Their brilliancy varies considerably at different oppositions. In the case of the earth and Mars the orbits are comparatively near each other at one part, and are much farther away at other parts. When an opposition takes place with the planets at the former points, Mars is nearer the earth than it is at any other time, and so appears much brighter. But if the opposition takes place with the earth and Mars at some of the latter points, the distance is so much greater that the maximum brilliancy of the planet is far less than it was in the previous case.

This variation of brightness is more marked in the case of Mars than in that of any other planet. The best possible oppositions are those that occur at the end of August, when the planet loops its loop under the Great Square of Pegasus. These maximum oppositions happen once in about fifteen or seventeen years; the last was in 1907, and the next will be in 1924, and will be absolutely the most favourable for the two centuries 1800–1999. The planet will then be only 34,650,000 miles from the earth.

The variation in the case of Jupiter is not nearly so much. For this planet the most favourable oppositions occur about October 6, when Jupiter is 369,000,000 miles away. The least favourable are those that take place in April, when the distance is increased to 411,000,000 miles. The other visible outer planet, Saturn, is so far away that the variation in its brilliancy is not at all a conspicuous feature of its oppositions; its brightness is, in fact, controlled by the inclination of the ring system.

A few words will probably suffice to explain the apparent movements of the inner planets, Mercury and Venus. It will be evident from the figure that they can never rise at sunset and remain visible all through the night as do those that lie beyond the orbit of the earth. They appear to vibrate, swinging from side to side of the sun. If the inner circle (Fig. 4) represents the orbit of Venus and the outer that of the earth, it is obvious that the greatest apparent distance of Venus from the sun is given when the line EV, joining the two planets, is a tangent to the orbit of Venus. This planet is visible for some months when it is coming into, or receding from, this position. Mercury, however, is visible to the naked eye for only a few days each year, when it appears like a white or silvery point flashing in the afterglow of sunset or just before the dawn.

Continued from page 327.]
cavities as shown in X-ray photographs, Prof. Elliot Smith is inclined to agree that it affords evidence of the existence of a primate, in some respects like the chimpanzee, but definitely human rather than ape-like and representing a type of the human race older than *Pithecanthropus* of Java. Dr. Smith Woodward, however, adhered to the opinion he had previously expressed that it was more likely to belong to the genus of extinct primitive bears known as *Hyænarctus*, and claimed that it was more like the upper molar of a carnivore than of a primate.

Reviews of Books

Age and Area. A Study in Geographical Distribution and Origin of Species. By Dr. J. C. Willis, F.R.S. With chapters by Hugo De Vries, H. B. Guppy, Mrs. E. M. Reid, and Dr. J. Small. (Cambridge University Press, 14s.)

The geographical distribution of plants over the earth's surface has long occupied the attention of naturalists, but it was Darwin's treatment of the subject in the *Origin of Species* which initiated a more scientific study of plant geography. " In considering the distribution of organic beings over the face of the globe," he wrote, " the first great fact which strikes us is, that neither the similarity nor the dissimilarity of the inhabitants of various regions can be accounted for by climatal and other physical conditions." Darwin held that every species began its existence at some one place, whence it gradually spread. Some species were successful travellers, while others lagged behind and never occupied more than a restricted area. The idea of multiple origins, that is, that the same species may have been created independently at more than one place, was superseded in the minds of most naturalists by that of single centres of creation. As Darwin said, " The simplicity of the view that each species was first produced within a single region captivates the mind." He also wrote : " As many more individuals of each species are born than can possibly survive ; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be naturally selected. The preservation of favourable varieties, and the rejection of injurious varieties, I call Natural Selection."

The doctrine of natural selection in Darwin's mind was intimately connected with geographical distribution. Dr. Willis, as he tells us in the Preface, was formerly a " pupil of the strictest school of Natural Selection " ; but, he adds, a course of " independent observation of nature," extending over several years, led him to shake off the trammels of the theory and compelled him to profess his belief that " Age as an explanation of spread is enormously simpler than natural selection." An analysis of the flora of Ceylon and, subsequently, of the floras of other countries, led to the enunciation of the hypothesis which is conveniently spoken of as Age and Area. In the volume before us Dr. Willis summarises and amplifies views previously published in various scientific journals. It is impossible in a short review to deal adequately with the many interesting problems raised by the author ; one can only draw attention to the salient features of the hypothesis and offer a few criticisms.

In Part I he deals with the present position of Age and Area. In the introductory chapter he writes : " For sixty years we have been under the wonderful fascination of the theory of evolution by means of infinitesimal variations, or minute changes of character from individual to individual." So far as I am aware, Darwin never speaks of variations as " infinitesimal." Seeing that Dr. Willis is a confirmed unbeliever in Natural Selection, it would have been better to quote Darwin's words and thus make clear the precise meaning which Darwin attached to that expression. Willis adds that the distribution of any species is governed by the interaction of many factors and physical barriers ; but while the various factors will be likely to act with some uniformity only on a group of allied species, age pulls all alike. The area occupied is largely the result of age : widely spread species are older than species confined to a small area. It is true that a recently evolved plant or animal has had insufficient time to travel far from its original home ; but it is equally true that many plants and animals of restricted range formerly occupied a larger territory. In other words, size of area is not a safe criterion of age. To get to the bottom of the history of organisms, we must consider the evidence of the rocks and take into account distribution in the past as well as in the present. The study of fossil plants shows unmistakably that many genera that are now confined within narrow geographical limits are survivals, and not young beginners. Dr. Willis admits that there are exceptions to his general rule ; but he considers their number insignificant. "Another popular theory," he says, " about localised species like these Ceylon endemics [species, genera, or other groups confined to a small area] is still strongly held . . . it is to the effect that species on very small areas are really in process of dying out. This hypothesis is supposed to be supported by the facts of fossil botany, which unquestionably proves that many species have existed in the past and no longer occur in the world to-day." The point is, not that fossil botany proves the former existence of species no longer represented in present-day floras—a fact universally admitted—but that it is no mere supposition that it also teaches us that many genera of plants now confined to small areas are very old types and in former ages had a wide distribution. There are many, not few, such genera. He deprecates conclusions based on individuals ; groups of ten species at least must be considered. But all facts must be taken into account in our endeavour to discover the truth.

Chapters are included on the dispersal of plants into new areas ; the introduction and spread of foreign species ; acclimatisation ; and other subjects. Part II is devoted to the application of Age and Area to the flora of the world, and its implications. In 1912 the author noticed that of the 1,028 genera in the flora of Ceylon, there are 573 genera with one species each, 176 with two species, 85 with three species, and so on. These numbers clearly show that genera with one and two species are much more numerous than genera with more species. An analysis of floras of many, both large and small, regions revealed the same state of affairs. If the genera of different floras are arranged according to the number of species they contain and the arrangement is expressed by curves, these exhibit a striking uniformity. The same type of " hollow curve " was obtained by treating

animal populations in the same way. In any country, and on the average, the larger families and genera, Dr. Willis says, will be the older, and will occupy the larger territory. To the idea of Age and Area he adds that of Size and Space. If groups of allied genera be dealt with, the size of a genus (i.e. the number of species it includes) is found to depend largely upon the area it covers, that is, "ultimately upon its age." The author's position is that natural selection no longer concerns us; there is a mechanical explanation of the facts of distribution. Age supplies a measure of distribution. The uniformity of the curves must be explained; there is clearly something underlying it. The question is, has Dr. Willis found the correct explanation?

He has written a stimulating book; it is not all easy reading, and one feels a suspicion that the author, carried away by his enthusiasm, did not allow himself enough time for critical revision of the manuscript. He has stated his case; and it is for those who disagree with the conclusions to state theirs. That Dr. Willis has rendered a valuable service to biological science the great majority of his readers will concede; he has directed attention to a subject which has suffered neglect, and in support of his thesis he has marshalled an imposing array of facts. The Age and Area hypothesis is simple; but I venture to think that it does not furnish a solution of the problem of geographical distribution considered in its broader aspects.

A. C. Seward.

Elements of Plant Biology. By A. G. Tansley, M.A., F.R.S. (George Allen & Unwin, Ltd., 10s.)

"This book is intended," the author states in the Preface, "primarily for medical students and others who do not necessarily intend to continue the study of Botany, but who desire or are obliged to obtain some elementary knowledge of plants, particularly in relation to general biology." In a recent number of Discovery, a book by Professor Dixon, on lines very similar to those followed by Mr. Tansley, was briefly reviewed. The two books have much in common; both are primarily intended for medical students; both break away from the more formal method, that used to be in fashion, of studying types rather from the morphological (that is, the aspect of biology concerned with form and structure) than from the physiological point of view; and both include admirable guides to practical work.

Mr. Tansley begins with a scholarly treatment of certain subjects of fundamental biological importance: the differences between plants and animals, organic substances and their chemical characters, some physical characters of organic substances, protoplasm and the *Amœba*, the vital functions, the cell. The suggestion may be offered that these more difficult subjects would come better after some account had been given of a typical green plant. It is easier to interest the beginner in the materials of which a plant is built after he has been introduced to the main features of a plant as a living organism—a complex and efficient machine—than to begin by descriptions of the nature of the materials of which organisms are constructed.

The main divisions of the plant-kingdom are then passed in review and illustrated by good descriptions of well-chosen examples: the lower plants are dealt with first, an order that is both logical and most likely to awaken the interest of students. Throughout the book the wider aspects of biology are kept in view, and frequent and apposite comparisons are made between plants and animals, both from the standpoint of construction in relation to manner of life and from the point of view of nutrition. Stress is laid upon subjects which may reasonably be regarded as essential parts of the equipment of a medical student, subjects which, indeed, should be included in any scheme of liberal education.

The book is clearly written and adequately illustrated: the presentation of the subject is characterised by accuracy and a philosophical outlook. It is probable that some beginners will find certain parts rather difficult, especially the chapter on "Some Physical Characters of Organic Substances"; but this surmise may be, and probably is, largely due to the fact that many of the older botanists—among which the reviewer includes himself—received their training in the days when textbooks of botany did not deal with such subjects as surface tension, surface energy, adsorption, colloids, and other phenomena, the importance of which in biology has only been recognised in comparatively recent times.

The most difficult art is to know what to omit; it is arguable that certain plants excluded by the author might, with advantage, have been included in place of some of those selected for treatment; but whether or not Mr. Tansley has made the best choice, the important point is that he has produced an admirable textbook, which may be strongly recommended not only to students in the narrower sense, but to all who wish to learn something of the mysteries of life and of the nature of the problems suggested by the word "evolution." One is sometimes asked to believe that it is superfluous for medical students to be expected to acquire a knowledge of botany. By his treatment of plant biology Mr. Tansley has supplied a very powerful argument in favour of the retention of botany in the medical curriculum, and has demonstrated the possibility of treating the subject on broad lines and making clear to any intelligent reader the position of plants in the general scheme of living beings.

A. C. S.

Secret Sects of Syria and the Lebanon. A Consideration of their Origin, Creeds, and Religious Ceremonies, and their Connection with and Influence upon Modern Freemasonry. By Bernard H. Springett. (George Allen & Unwin, Ltd., 12s. 6d.)

Several attempts have been made to connect the Masonic order with the mystic religions of the East; but they have not commended themselves to the majority of members of the Craft. Dr. Churchward, in his *Arcana*

of Freemasonry, endeavours to show that Masonic ritual can be traced back to early prehistoric times. Although Mr. Springett's aim is more restricted, his book links on to Dr. Churchward's work in that he suggests a connection between the cults which he here brings under review with sun and stellar worship through the religions of ancient Egypt and Mesopotamia. The scope of the book is wider than the title indicates; it covers not merely the sects of Syria, such as the Nusairi and Druses, but deals with most of the mystic religions of Western Asia, the Eleusinian mysteries, Mithraism and Gnosticism, as well as with Mohammedanism and its principal sects, Shia, Sufi, Ismaeli, and the like.

It may be noted in passing that the author has no first-hand knowledge of this part of his subject, but merely summarises from his particular point of view the accounts of other writers, not all of whom would now be regarded as authoritative.

Mr. Springett's theory is that the present ritual of Freemasonry is derived from the European continuations of the ancient mysteries, and, in particular, from the Manichæan doctrines perpetuated by the Crusaders. The tradition, he holds, was carried on by bodies founded by the last Grand Prior of the Knights Templar when that order was suppressed. The connection between the rites of Freemasonry and the heretical beliefs of the Templars has been suggested before. It is doubtful how far the Templars did hold the beliefs attributed to them. The author relies upon the charges brought against them at the time of their suppression; but the evidence would not now be held to be conclusive, and confession under torture is not proof. Mr. Springett suggests that the Templars had modelled their organisation on that of the Assassins, the Ismaeli who followed the "Old Man of the Mountains." Although the Crusaders were in close touch with the Western branch of the Assassins, and were, on at least one occasion, in alliance with them, the resemblances in the two organisations are merely superficial. As no note was made of the contents of the records of the Assassins until after their destruction by the Mongols, our knowledge of their tenets and organisation is not necessarily accurate—a fact which may account for some of their remarkably peculiar features.

It cannot be said that Mr. Springett has proved his case: where he sees identity his readers will probably see little more than an interesting similarity. Throughout connection is assumed rather than demonstrated. The author's lack of archæological knowledge has led him to formulate theories which will not bear critical examination, and to accept the conclusions or dogmatic statements of others which can no longer be maintained. Druids and Phœnicians are called upon to play a part in support of theory to which we have ceased to be accustomed. In minor details the author has not escaped error; the Pole star is not in Ursa Major, and it is to be presumed that, in alluding to the decipherment of the Babylonian and Assyrian tablets, the author really intended to refer to the Behistûn inscription, and not, as he does, to the Rosetta Stone.

E. N. Fallaize.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Secret Sects of Syria and the Lebanon. By Bernard H. Springett, P.M., P.Z. (George Allen & Unwin, Ltd., 12*s.* 6*d.*)

The Supremacy of Spirit. By C. A. Richardson, M.A. (Kegan Paul, Trench, Trübner & Co., Ltd., 5*s.*)

Among the Head Hunters of Formosa. By Janet B. Montgomery McGovern, B.L. With a Preface by R. R. Marett, M.A., D.Sc. Illustrated. (T. Fisher-Unwin, 15*s.*)

Stories from the Early World. By R. M. Fleming. With an Appendix by Prof. H. J. Fleure, D.Sc. (Benn Bros., Ltd., 15*s.*)

At Home with Wild Nature. By Richard Kearton, F.Z.S. Profusely illustrated. (Cassell & Co., Ltd., 7*s.* 6*d.*)

PSYCHOLOGY

Beyond the Pleasure Principle. By Sigmund Freud, M.D., LL.D. (The International Psycho-analytical Press and George Allen & Unwin, Ltd., 6*s.*)

Studies in Psycho-analysis. By Prof. C. Baudouin. Translated by E. and C. Paul. (George Allen & Unwin, Ltd., 12*s.* 6*d.*)

Remembering and Forgetting. By Prof. T. H. Pear, M.A., B.Sc. (Methuen & Co., Ltd., 7*s.* 6*d.*)

SCIENCE

The Principle of Relativity, with Applications to Physical Science. By A. N. Whitehead, Sc.D., F.R.S. (Cambridge University Press, 10*s.* 6*d.*)

These lectures expound an alternative rendering of the theory of relativity. The book is divided into three parts. Part I is concerned with general principles and is mainly philosophical in character; Part II is devoted to physical applications; Part III is an exposition of the elementary theory of tensors. No part of the book is easy reading; it is not another popular book on relativity—Einstein diluted at Aldgate pump; it is indeed for students of the most serious class only. To appreciate Dr. Whitehead's arguments and points completely a reader must be philosopher, physicist, and mathematician in one, and few there be who are such.

The Manufacture of Dyes. By John Cannell Cain, D.Sc. (Macmillan & Co., Ltd., 12*s.* 6*d.*)

A posthumous work, edited by Dr. J. F. Thorpe, intended as a supplement to an earlier volume, *The Manufacture of Intermediate Products for Dyes*, and one of the first compilations in English of the methods actually used in making dyes.

Inorganic Chemistry. A Textbook for Schools. By E. J. Holmyard, B.A. (Edward Arnold & Co., 6s. 6d.)

A book for candidates for the School and Higher Certificate, by the head of the science department at Clifton College, up-to-date, well-arranged and carefully written. The physical chemical side of the subject is well done, and the sections on the structure of atoms and molecules and on the Arabs' contribution to mediæval chemistry are excellent.

An Introduction to Forecasting Weather. By P. Raymond Zealley, F.R. Met. Soc. (Cambridge: Heffer, 1s.)

The Microscope. A Practical Handbook. By Lewis Wright. Enlarged and revised by A. H. Drew, D.Sc., F.R.M.S. (Religious Tract Society, 5s.)

Radio for Everybody. By Austin C. Lescarboux. Edited by R. L. Smith-Rose, M.Sc., D.I.C. (Methuen & Co., Ltd., 7s. 6d.)

General Astronomy. By H. Spencer Jones, M.A., B.Sc. (Edward Arnold & Co., 21s.)

A Second Course in Engineering Science. By P. J. Haler, M.B.E., B.Sc., and A. H. Stuart, B.Sc., F.R.A.S. (University Tutorial Press, 5s.)

Correspondence

SECONDARY SEXUAL CHARACTERISTICS

To the Editor of Discovery

Sir,

Dr. Mottram's letter in your October number raises a number of interesting points, to some of which I will attempt to reply here. In the first place, I must plead guilty (p. 201, l. 17), under the exigencies of space, to attaching undue emphasis to the necessity for stimulation of the female by the male. When " courtship " occurs, this is its *usual* form ; but the reverse occurs, e.g. in Phalaropes, and comparatively often there is *mutual* stimulation.

This brings me to Dr. Mottram's specific criticism. He points out that many birds are alike in both sexes. On the other hand, he fails to distinguish cases in which the sexes are alike but protectively coloured, from those where they are alike but brilliantly coloured and often possessed of special adornments ; he further fails to distinguish between those in which, although the sexes are alike, the males alone perform " courtship " actions (e.g., most Warblers), and those in which " courtship " is a mutual affair—both sexes playing similar rôles (e.g. Herons, Grebes, Divers, Fulmars, etc.).

As a matter of fact I have published (*Proc. Zool. Soc.*, 1915) an account of the sexual ceremonies of the Crested Grebe, where (and in the *Auk* 1916, and in *Nature* 1921) the matter is discussed, and it is made, I think, clear that such " mutual courtship " may lead to the development of bright colours and special structures in *both sexes* simultaneously.

I have since then investigated the courtship of Divers, Egrets, and other birds, and have a paper in press for the *Proc. Linnean Soc.*, to which I must refer Dr. Mottram for a full theoretical discussion of the very interesting questions he raises as to protective coloration and the similarity of the two sexes, together with numerous other points.

I am grateful to him for having pointed out the error in my presentation. I should have said something like this : " As mind develops, new complications arise. Emotional stimulation is often necessary before sexual union can be consummated. Largely from this cause there have arisen the ceremonies and displays of courting animals."

On the other hand, his criticism seems to me to be based on a rather extensive lack of acquaintance with the actual facts of " courtship " (to use that unsatisfactory but generally-accepted term). No one who has not studied in detail the actual occurrences associated with display and other sexual ceremonies in birds can have an idea of their complexity, or a right to indulge in *a priori* theorising on the subject. I can at least claim that the conclusions which I have reached—for a detailed presentation of which, I repeat, I must refer Dr. Mottram to my forthcoming paper—are based on careful field study reinforced by over ten years' thinking and digging into the literature.

There are a great many complicating factors ; but there is absolutely no doubt in my mind that there does exist a relation between (1) a certain level of mental organisation ; (2) the performance of so-called courtship ceremonies by one or both sexes ; (3) the acquisition of bright colours, special structures, or stimulating qualities of voice or odour, in *one or both sexes.*

These characters developed in relation to courtship can best be called by Poulton's term *epigamic*, as their function is subsidiary to the union of male and female sexual cells.

It is an extraordinary thing how little work has been done on a study of sexual ceremonies, even in common British birds. For instance, until Eliot Howard's monumental *British Warblers* appeared, in 1907 to 1914, no satisfactory description, much less interpretation, had ever been given of the relations of the sexes in any single species of the group !

Anyone who is fond of natural history, has plenty of patience, a field-glass and a notebook, and does not mind now and again getting up early in the morning, can contribute valuable material to this branch of science and to the theory of sexual selection. The story even of the Robin is not properly known ! The Tits, the Woodpeckers, the Waders, the Wagtails, the Kingfisher—comparatively little has been discovered about the sexual relationships of these groups, to name but a few as they come into my mind.

I cannot better close this letter than by appealing to the amateur ornithologist, not merely to collect records

of birds like so many stamps, nor even only photographs of birds, but to have a definite problem in his mind which he can solve by persistent watching, by penetrating into the secrets of the birds' intimate life.

Yours, etc.,
JULIAN S. HUXLEY.

NEW COLLEGE,
OXFORD.
October 14, 1922.

THE PROBLEM OF PERSONALITY

To the Editor of DISCOVERY

SIR,

I have read with much interest Mr. J. S. Huxley's letter on this subject, and agree with him that personality cannot be a thing independent of the organic structure and physiological life of the person. There are, however, some important aspects of natural personality which he does not deny, but fails to note ; and on these I should like to be allowed to say a few words.

An individual organism cannot be regarded as a mere product or passive outcome of the two factors, heredity and environment. Each organism is *itself*, being a unique centre of relations, both to its progenitors and possible descendants, and to its presently-conditioning surroundings—to the ground and air (or water) and plants and animals in the particular terrestrial place or series of places in which it lives, and to the particular portions of food which it assimilates. Even a pebble, though devoid of life and growth, is *itself*. It is not any *other* pebble which may happen to be its exact counterpart in shape and substance. Nor is it wholly a product of antecedent and external forces. Its own substance is a small part of what was the substance of its parent rock, but the form which it acquired in breaking away therefrom gives it a separate identity, and, if it has since been rounded and polished by the action of the waves, its own substance and its own original form were both necessary conditions of what it has now become. The formation of a pebble through essentially disintegrative forces is, of course, a process very different from the regular integrative development of an organism ; but I suggest that the *selfhood* of each living organism cannot be something less, and is, in fact, something much more, than the selfhood of each pebble. The organism is not a thing made by abstract conditions called " heredity " and " environment," but a thing which makes itself in accordance with certain hereditary tendencies and with the external means which it finds for their exercise.

While the above would be true of an individual plant, it is only in the case of animals, with their nervous systems and powers of contingent activity, that selfhood appears to be dimly *felt*, and only in the case of human beings that it comes to be *clearly reflected upon*. It is, I suggest, with the reflective knowledge of selfhood that what is properly called " personality " arises. A scientific induction associates personality and personal consciousness with a part of the brain and nervous system but the person's " common sense " has previously associated them with the sensitive skin-envelope, the eyes in looking, the ears in hearing, the voice in speaking, and with all voluntary muscular actions, and has, at the same time, contrasted these outward instruments of personality with the inner stream of perception, thoughts, emotions, desires, and decisions.

Personality differs from actual consciousness, or presently-passing experience, in that it involves permanent aptitudes for perceiving, thinking, feeling, and willing in a great variety of different ways, according to the particular situations presented to our senses or the particular thoughts evoked by listening to speech, reading, writing, or meditating. Very little of all that we are accustomed to perceive or do or think or feel can be simultaneously presented to consciousness ; and hence our knowledge of our own personalities, like that of our inner bodily organisms, is mostly indirect. In actual consciousness the awareness of personality seems to consist in a general sense of one's personal powers connected with some memory of one's past experiences. This awareness, absent in sound sleep, is curiously travestied in dreams, while personality itself is perverted in the mental aberrations of the insane, some of whom seem to have dual personalities.

As an aspect of the whole person, personality is the mental and morally social, not the physical and physiological aspect. It is the person's character—his distinctive type of human nature—in which the instincts derived from animal or low human ancestry are more or less controlled or sublimated by ideas and ideals, beliefs and reasonings, due to educative influences and personal reflection, and constituting personal intelligence. Only at its best does such intelligence approximate to true reason. True reason is not egocentric, but actuated by the objective interests of careful observation and clear thinking and allied to human sympathy and the sense of justice, which are, together with it, the conditions of personality developing on other than merely selfish lines.

Mr. J. S. Huxley says that environmental factors " undoubtedly play a relatively small part in forming personality compared with those which are hereditarily determined." Here I cannot agree with him, as I think that the normal human brain must be made by the evolving individual life (not *wholly* on ancestral lines), that it is an extremely plastic instrument, and that most of what a civilised human being *is* is derived from the social culture-heritage, the elements of which are imparted to him by education and the personal influences of those with whom he comes in contact from childhood upwards. This fact, if it be such, cuts both ways, ethically speaking. Many of the traditional beliefs on which so-called civilised people are taught to conduct their lives are as pernicious as are any of the primitve instincts derived from their savage or barbarian ancestors, and may indeed afford shelter and excuse for such instincts. On the other hand, there is hope that mankind's wisdom will increase, as genuine knowledge, based on observation, experiment, research, and reflection, is made widely accessible, and especially as the habit of sincere personal thinking—

a most important factor in shaping adult personality—is widely stimulated.

Yours, etc.,
CHARLES E. HOOPER.

SOUTHAMPTON.
August 13, 1922.

To the Editor of DISCOVERY

SIR,

For many years I shared the difficulty which Mr. Rogers mentions in his letter. The confusion that arises in the mind when one tries to understand psychological terminology is most embarrassing. I gave up the chase of the meanings of the words as shown in literature and went direct to the source whence the word arose. On that I settled the meanings for myself, and I have never had to retrace my steps. There are three words which occur continually and are used interchangeably by nearly all writers, just as if one had the same meaning as the others. Therein the difficulty arises, and not in the meanings of the words themselves. The words are Personality, Individuality, Spirit. They all refer to the human being.

As I understand it, Personality comes from *Persona*, which means a mask or covering, and is used in many senses, such as *Dramatis Personæ*, in which the actor is disguised by his garb. In psychology or metaphysics it would mean the body which covers the spirit or actor beneath it. Individuality comes from *Individuus*, which means that which cannot be divided. It cannot refer to the body, for that can be divided into parts. It must refer to something immaterial, and that something, I think, is the mind, which is indivisible and one, and is the result of the combination of the spirit and the body.

Spirit comes from *Spiro*, which means breath or motion or movement, and is immaterial also. It is the power which makes all movement of the body, whether it be conscious or involuntary.

If these basic definitions are adhered to they will explain the whole subject. In practical work I have found them to be sufficient for general use; that is, I think, the best test that can be applied. So far as "strictly scientific method of investigation" is concerned, I would say that if by "scientific" is meant "materialistic," it is impossible to give any proofs at all, but if it means the seeking of truth, we can see at once, in the case of the still-born child and the recently deceased adult, that something has not been imparted to the first and has departed from the second, and that something cannot be called nothing, seeing that it is *the* factor by which all movement and intelligence was made manifest.

The real difficulty has arisen from the determined exclusion of the ethereal from the scientific mind. It is often said by scientists that "where the supernatural begins, science ends," but surely everything on earth is natural, especially if it is alive. Spirit is natural and not unnatural. Individuality is natural, not unnatural or supernatural. Whilst the idea persists that there is something supernatural, so long will difficulty and stagnation exist. As soon as we realise that all that is on earth is natural, the innumerable difficulties that exist to-day will vanish. There is no dividing-line, for one seems to overlap and to intermingle with the other, yet they are separable—which is a paradox.

Yours, etc.,
SAMUEL GEORGE.

GLACK,
DEAL.
September 27, 1922.

ENGLISH PLACE-NAMES

To the Editor of DISCOVERY

SIR,

My letter in your last issue did not aim to give all the evidence I have available on the points I mentioned. Space forbade that, and my book on *Early British Trackways* was written (probably with many faulty place-name surmises) to explain and introduce this new framework for investigation.

As regards the Bowley place-names I mentioned, Canon Bannister (*Place-names of Herefordshire*) gives this same Bowley as being *Bolelei* in Domesday Book; and there is another ancient Bowley Lane in Herefordshire. Looking up the *bol* or *bole* place-names, I went to Bollingham (no old forms available) to find the bol, not recorded in map or record. But there it was, a conical tumulus in a shrubbery, close to chapel and house, with a summer-house and a dovecot on its apex. I investigated Bolitree, sometimes called a "castle"; the house is raised a little as if on a mound, and round it are traces of a moat.

My deductions about the meaning of the "red," "white," and other place-names have not started as a theory, as critics assume. I was not thinking about place-names at all until I found the straight tracks I had discovered (sighted over moats, mounds, etc.) also linked up in some cases place-names of one type. I should have been glad if place-names could have been kept out of the investigation altogether, but it was impossible, as they shout out to the investigator information which he cannot ignore.

Of course, the truth of what I pointed out all hangs upon the question whether straight-sighted prehistoric trackways really existed. I do not expect this to be fully accepted until well confirmed; and fortunately it is already receiving full confirmation from other observers —Mr. W. A. Dutt, of Lowestoft, author of *Highways and Byways in East Anglia*, for an instance.

Ought we not to recognise that a keen topographical knowledge and insight is not always joined in the same person with a skilled knowledge of words and their roots in the scholar's sense; and that, again, academic conclusions are often absurdly wrong for want of the special knowledge of the place, as well as that of the name? Here co-operation might score.

Yours, etc.,
ALFRED WATKINS.

HEREFORD,
November 3, 1922.

[Owing to lack of space we have unavoidably had to hold over to the January No. a most important letter from Prof. Mawer in answer to the above letter.]

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Edited by EDWARD LIVEING, B.A.
Scientific Adviser: A. S. RUSSELL, D.Sc.

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LIST OF CONTRIBUTORS

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Editorial Notes

WITH this number DISCOVERY enters the fourth year of its existence. During the last year many advances were made in all branches of the Arts and Sciences. With those advances it has endeavoured to deal in articles that have avoided, as far as was possible, the technical language in use in each branch without at the same time losing sight of the necessity for an accurate and truthful interpretation of the results obtained by the careful research worker. To mention only a few articles, our journal has kept abreast of the steadily increasing use of wireless telegraphy, the new researches into the nature of radio-active elements, recent developments in aeronautics, the economic difficulties which have harassed Europe and our own country during 1922, the brave second attempt to climb Mount Everest, some intensely interesting archæological discoveries in Egypt and Greece, the attempts to solve a variety of physiological problems, and some striking new theories put forward by the psychologist.

* * * * *

In our columns Professor Flinders Petrie has described the method he has been employing in Upper Egypt to reduce to historic order "what is usually called the Prehistoric Age"; Professor Alfred Wegener has given the first description in English of his new theory of the origin of continents and oceans; Mr. Julian Huxley has outlined his researches into the problem of sex and its determination; and Professor Zammit has written about his excavations at Malta of some remarkable monuments belonging to the later Stone Age. Again, the meeting of the British Association at Hull this year brought many new problems and attempted solutions thereto before the public, including M. Coué's theory of auto-suggestion, and a problem which is at present receiving a great deal of attention from anthropologists, namely the study of the mental characteristics peculiar to different races. Here again we have endeavoured to supply our readers with careful accounts of what our famous scientists and intellectuals are thinking and doing to-day.

* * * * *

A question which is receiving steadily growing attention at the hands of both the psychologist and the physiologist is the relationship between body and mind. At present the results obtained cannot be considered as anything but indefinite. In this direction a fuller co-operation between these two lines of study is necessary. It must be quite obvious to all educated men and women that in this field of knowledge science is destined to play a very important part in the life of the community, for in touching upon the basis of human personality it cannot fail to be reflected in what is still one of the most important backgrounds of all human life and action, namely religion. How deeply this problem is being discussed by everyone who ever gives a thought to the question of why he is existing upon this planet was illustrated in a most interesting way by the large quantity of correspondence which reached this journal as the result of a discussion in the *Editorial Notes* last April concerning an American book published a few months previously on the subject of the influence of the ductless glands on personality.

* * * * *

This correspondence showed us very clearly how, apart from the object of placing new or attempted discoveries before our readers, we need to find out from them what influences such discoveries are creating in the individual's life and thought, and his attitude to these new conceptions. In many trials the expert, be he a doctor or a specialist in finger marks, is consulted, but the laymen in the shape of the jurymen

give the verdict. Every respect and honour must be given to our contemporary pioneers of knowledge, but we feel that encouragement cannot fail to assist them. The finest form of encouragement is the interest shown by our thinking public. It is to promote that interest, and to ascertain into what channels that interest runs, for which DISCOVERY stands. Our readers will be doing a service to themselves, their journal, and the cause of intellectual progress if they will inform us of the special subjects which interest them and, generally, of their ideas and wishes concerning the conduct of DISCOVERY.

* * * * *

There were some very sharp criticisms expressed in England a few months ago when a report was received that a new German drug for the cure of sleeping-sickness would be kept secret in the interest of German colonial schemes. We heard it said that this was a typical example of German ways of thinking—an unkind comment on the land that gave us Koch's treatment of tuberculosis, to mention only one of its services to medicine. Our national sense of superiority must have received a shock recently to learn that the production of "Insulin," a substance used in the treatment of diabetes, was to be controlled. There was some hint of the same spirit in the suppression of formulæ for a lead compound which is being tested in cancer by workers in Liverpool. We need not say that there is no suggestion that in either case were the motives of the investigators other than creditable. The fact remains, however, that we must face a new attitude towards scientific remedies for disease. Their usefulness is to be examined by a minority; their development, if it comes at all, must come from a small group of experimenters.

* * * * *

It is argued that a misapplication of a valuable agent for the relief of disease may lead to its discredit. This, of course, is a different motive for secrecy or control than that which inspired the commercial exploitation of the first forceps employed in child-birth. But is it a fact that a really valuable invention loses anything by the widest possible investigation and development? We owe a great deal to the large English manufacturing chemists for their modifications of such drugs as thyroid gland, quinine, and chloroform. The wish to restrict investigations to a selected body of men is in truth a form of egotism. Not even the most eminent scientist is the seat of all learning; even if he were, he could not hope that all the fortunate accidents which often bring success would happen to him and to him only. The freemasonry of science is its great glory and its great advantage in the search after truth, and any tendencies to a narrowing of the fields of research are unwelcome.

The First World Flight Attempt

By Major W. T. Blake

[The first attempt to fly round the world was organised by Major W. T. Blake last year. The three participants in the flight were the author, Captain N. Macmillan, and Mr. G. Malins. In this article Major W. T. Blake gives his first complete description of the flight to appear in an English magazine.—ED.]

AT 3.7 p.m. on 24th May last year we left Croydon Aerodrome, subsequently reaching Paris and Lyons, whence we intended crossing the Alps. On reaching Chambéry we found the whole mountains shrouded in mist, making the passage too risky to attempt. I therefore passed a note to Macmillan, who was piloting the machine, to proceed due south for Avignon and Nice. Shortly afterwards our trouble began. When over Aix-en-Provence the engine began to run extremely badly, and it became necessary to land as soon as possible.

A Forced Landing at a Race-meeting

At Lyons we had been told that there was an aerodrome at Marseilles, and we therefore headed for this city. We arrived over Marseilles to find it situated in the midst of country, with hills, boulders, and ravines, with no single space in which it would have been possible to land a machine for miles around. In the city itself the only possible place was a small race-course, surrounded by trees and houses, and more than half covered by what we afterwards discovered to be stands erected for a gymnastic display. A race-meeting was in progress.

After flying low over the course to inspect it thoroughly, Macmillan turned in, threw the machine into a vertical side-slip, coming over the stands, flattening out at the last possible moment and nearly bringing off the landing. Unfortunately there was a ditch across the only open part of the race-course. This caught the left wheel of the under-carriage, crumpling it up and throwing the machine on to her nose, the tail shot into the air and I was jerked violently forward in my seat. For a moment the machine stood almost vertical on her nose, undecided whether to turn right over or to fall back. Then she fell back on to her tail skid. The only damage was to the under-carriage, a broken propeller and a broken wing skid.

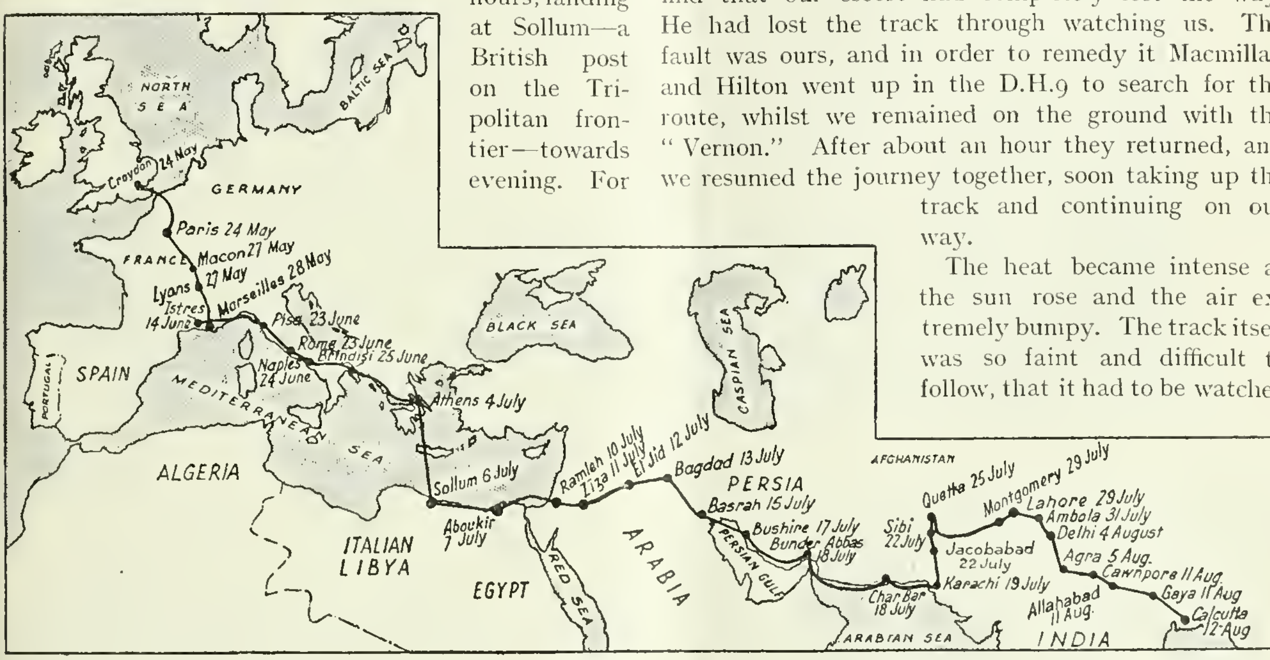
Our repairs here, owing to our having to dismantle the machine, occupied three weeks, but on 23rd June we took off once more and flew to Pisa, Rome, Naples, Brindisi, and across the Adriatic to Athens.

Above Vesuvius

As Vesuvius was in a mild state of eruption, we

took the opportunity of flying over the volcano in order to see what it looked like from the air. Little could be seen except volumes of sulphurous smoke and steam, with a red glow in its heart. The sides of the volcano were seamed with lava streams. As we flew straight into the clouds, we were bumped and rocked violently from side to side and shot about 600 feet into the air. The taste of sulphur, which is stated by scientists not to be present in Vesuvius, remained in our mouths for days afterwards.

Our crossing of the Mediterranean from Athens was entirely uneventful. The engine—a 240 h.p. Siddeley Puma—ran perfectly throughout. We accomplished the journey of about 500 miles in four and a half hours, landing at Sollum—a British post on the Tripolitan frontier—towards evening. For three hours of our flight we were out of sight of land and saw no sign of any vessel, so that, had we come down in the sea, we should not have been picked up again.



SKETCH MAP SHOWING THE ROUTE FOLLOWED BY MAJOR BLAKE ON HIS ATTEMPTED WORLD FLIGHT.

Next day we continued our journey to Aboukir, near Alexandria, and from thence to Ramleh and Ziza on the western edge of the Arabian Desert, where we were to pick up a R.A.F. machine which was to escort us across the desert.

The desert crossing is not made by taking a compass course as most people would imagine, but by following the track of motor-cars which were run across from Amman to Ramadie some time ago. All aircraft have to hold closely to this route, so that, in the event of a forced landing, machines can be sent out from either end, and by following the track cannot fail to find the stranded pilot. Landing grounds are marked at intervals across the desert.

A Descent in the Arabian Desert

The first incident of the day was when we lost the way. In order to get good kinematograph pictures of our escort—a Vickers "Vernon"—we had edged too near to her. Flight-Lieut. Hilton, the pilot, naturally wondered what we were doing, as there was plenty of room in the desert, and so had to keep a careful eye on our manœuvres in order to obviate the risk of a collision. We were flying rather low, less than 1,000 ft. above the ground, and suddenly, to our surprise, the "Vernon" throttled down and landed on a mud flat. We followed suit, only to find that our escort had completely lost the way. He had lost the track through watching us. The fault was ours, and in order to remedy it Macmillan and Hilton went up in the D.H.9 to search for the route, whilst we remained on the ground with the "Vernon." After about an hour they returned, and we resumed the journey together, soon taking up the track and continuing on our way.

The heat became intense as the sun rose and the air extremely bumpy. The track itself was so faint and difficult to follow, that it had to be watched intently, for which reason it was impossible to rise high into the air to avoid the bumps, for we could not see the trail at anything above a thousand feet.

After about another hour and a half's flying the "Vernon" again landed, and once more we followed suit. This time our escort had developed engine trouble. Throughout the day work was done on the "Vernon's" engines, and towards evening Hilton tried to make another start, but the engine was still out of order, and eventually we set out alone, hoping to cover more than half the distance to Baghdad before nightfall and resume our journey early in the morning.

An Oasis and Some Friendly Arabs

Realising that water was running short through

our various delays and that there was only one well between Ziza and Ramadie, we determined to land at El Jid, a tiny oasis in the desert, in order to replenish our bottles. We came down somewhere near the well, and, leaving Macmillan to look after the machine, Malins and I started off with our water-bottles. We had only gone a few hundred yards when Arabs came up to us. They were armed and savage in aspect, but the sheikh and his sons threw their arms round our necks and kissed us on both cheeks, talking voluble Arabic, which was incomprehensible to either of us. At last, getting more and more excited in his efforts to make us understand, the sheikh drew his hand across his throat, at the same time making suggestive noises and pointing in the distance. For a moment I wondered what was about to happen, and then it dawned on me that he was referring to the killing of a sheep—a well-known Arab custom. Fortunately I found a Bedouin who could speak the Egyptian Arabic, of which I knew a little. He told us that the sheikh's children had seen us coming, whereupon the head of the tribe had given orders for a feast to be prepared in our honour, for he was very well disposed towards all flying men, since they had once helped him in great trouble.

Being anxious to push on, I declined the feast, but he was not to be outdone, and the newly killed sheep, flayed and dripping with blood, was brought along to us and thrust into the machine. Next, a skin of curdled goat's milk was produced, and of this we had to drink cup after cup. Finally, in order to pay me a great compliment, the sheikh thrust a dirty hand down into the skin and produced a handful of curds, which he squeezed into a ball and pushed into my mouth as a mark of great favour. This was the climax. All of us were making heroic efforts not to be sick. We distributed chocolates, cigarettes, and handfuls of foreign coins, then climbed into the machine and vanished into the night, for by then it was already growing dark.

NAPLES, PHOTOGRAPHED FROM THE D.H.9.

Luckily this part of the desert is all fit for landing on, and in about twenty minutes' time we came down once more. Our first act was to be violently sick, after which we rushed to the locker for our whisky bottle, only to find that it was missing, having obviously been stolen at one of our previous stopping places.

We spent a miserable night in the desert. Our only food was Bovril spread on hard biscuits similar to those supplied to dogs, but which are considered good desert rations for the Royal Air Force. On their being broken, maggots and beetles dropped out. Our water supply was very low and so hot as to be almost undrinkable. Macmillan and I lay down on the desert under the tailplane, having first dug holes for our hips, for the surface was hard and stony. Malins spread himself out in the cockpit of the machine and tried to sleep in that manner.

Owing to our numerous halts and detours, our petrol began to give out, and next day, when some

twenty odd miles from Ramadie, we landed to see if there was enough spirit to carry us there. Not one of the five tanks contained more than a few pints of petrol, but, by draining each of them and pouring the contents into one of the gravity tanks, we just managed to scrape up enough to get to the aerodrome in time to find two R.A.F. machines about to start in search of us.

Spiralling "Dust Devils"

After two days' rest, we set out for Basra on 15th July, accompanied by a D.H.9a, piloted by Flying-Officer Hewson, of the Royal Air Force. It was an extremely bumpy flight, with spiralling "dust devils" rising to a height of over 7,000 ft.

We passed safely down the Persian Gulf, and on 19th July met with a splendid reception at Karachi, our first landing in India, where we were presented with an address in a silver casket and a wonderful Persian carpet. Our appearance must have been remarkable, for we had not shaved for several days and were burnt almost black by constant exposure to the sun and wind. I was attired only in a shirt, with no collar, sleeves cut off at the shoulders, open to the waist, shorts coming halfway to my knees, no stockings, and slippers.

Across India

It was our intention after leaving Karachi to cross India via Nasirabad, Delhi, and Allahabad, but whilst at Karachi we were told by the headquarters of the Air Force at Amballa that we should proceed not to Delhi, but to Amballa via Multan and Lahore. When we were on the point of departure a message came through to say that the River Indus had burst its banks and the aerodromes en route to Lahore were under water. We were therefore advised to proceed via Jacobabad or Sibi.

On landing at Jacobabad we found that it was simply an emergency landing ground with no petrol supplies. We continued to Sibi, and there found a rather similar state of affairs. Engine trouble set in, and, after communication with Quetta, we decided to go on to that station to have the engine set right and make arrangements for the necessary petrol with which to proceed to Lahore.

We then loaded up again and continued to Lahore and Amballa. Here our troubles started again. We tried several times to leave Amballa, but each time were forced to return with a failing engine. The climate had caused the rubber petrol connections to rot, and pieces of rubber were blocking the petrol pipes and choking the carburettors. Time after time we flushed out the pipes and cleaned the tanks, and though we fitted new connections the trouble continued.

We left Amballa on the 4th August, but when a few miles past Delhi, where we had not intended to land, the engine again cut out, and we were forced to descend in a ploughed field. Again Macmillan brought off an excellent landing without damaging the machine in any way, but we found that in order to get off we should have to move the aeroplane to a road some three-quarters of a mile away, over ditches, through hedges, and over a railway. Hundreds of Indians were lent us by the Public Works Department, and these began to fill in ditches, cut through banks, and chop down trees, whilst helping us to haul the machine across the country. Before we had finished night fell and a terrible thunderstorm blew up. Rain fell in solid sheets, thunder crashed continuously overhead, and the flashes of lightning were so vivid and frequent that we were enabled to carry on our work by this light. Soaked to the skin and wading about in a sea of mud, all our helpers worked with a will, so that we succeeded in getting the aeroplane on to the road before we turned in for the night.

PREPARING TO LEAVE QUETTA.

Flying Through a Monsoon Storm

Before we reached Agra we ran into another of the terrifically dense monsoon rain-storms. Afterwards we found that five inches of rain fell in a few hours. Our engine again developed trouble, and we landed before it actually "cut out." The propeller fabric had been stripped off by the rain, and lumps of wood were eaten out of the edges of the propeller. On inspection it was found that it was hopeless to try to continue with the engine as she was, and for a time I was somewhat at a loss as to how to proceed.

Fortune favoured us this time. I was told that the Maharajah of Bharatpur, who lived some thirty miles away, had a number of aeroplanes of exactly the same type as that which we were using. He lent us an engine, and his mechanics installed it.

At Agra, which we had reached on 5th August, I was overtaken by illness and was carried to hospital suffering from appendicitis, but despite the advice of the authorities, I decided to push on to Calcutta and prepare things for the next stage of our journey. Shortly after my arrival Macmillan and Malins arrived, having made the journey from Agra via Cawnpore, Allahabad, and Gaya in two days. This was the end of the first stage of our flight. We had covered over 10,000 miles by air, and had flown over some extremely bad country under the worst possible conditions. Among other things, we had flown the Mediterranean from Athens to Sollum on a land machine—a feat never previously attempted—and we had crossed India during the worst part of the heaviest monsoon in living memory—a thing said to be impossible.

The Final Disaster

Whilst I was in hospital recovering from my operation, Macmillan and Malins left on our second machine, the Fairey seaplane, bound for Rangoon. An airlock forced them to descend in the Bay of Bengal, and they floated about for two days and three nights before they were rescued on 24th August by Lieut.-Commander Cumming, who had been sent out from Chittagong to search for them. Their experiences were terrible. It was only due to the fact that clouds obscured the sky and rain fell most of the time that they got through alive, but had the rescuing tug arrived half an hour later it would have been too late, for the machine broke to pieces almost as they left it.

Though we did not succeed in our object, we gained a great deal of experience in flying over this part of the world, and hope that next year, if all goes well, we shall be able to carry out what we attempted.

Pencil Pigments in Writing [1]

By C. Ainsworth Mitchell, M.A., F.I.C.

The examination of pencil pigments in writing has not until recently attracted the attention that has been paid to inks, doubtless because it was regarded as unpromising. Actually much less can be deduced from pencil than from ink marks, but such facts as emerge are not without interest.

Schönemann mentions, in a curious book of his published at Leipzig in 1818, that codices of the eighth and ninth centuries contained vertical parallel markings made with a stylus, whilst from the eleventh century onwards these lines were ruled in black lead. Now graphite (black lead) was not discovered, or at least used as a pigment, until 1566, so that apparently Schönemann must have mistaken markings in metallic lead for graphite.

The microscopical appearance of lead and its alloys is quite distinct from that of graphite, the lines showing a disconnected series of patches irregularly distributed and uniformly and brilliantly lit up, and each patch is marked with regular vertical striations. This is shown in Fig. 1.

I called attention to this apparent anachronism in Schönemann's observations in a communication to *Nature* (1920, **105**, p. 12), and this drew from Professor Flinders Petrie a reply that he could give me a portion of a fragment of graphite which he had discovered in a tomb at Ghorub, in Egypt, and which must have dated back to a period between 1500 and 1200 B.C. This specimen of graphite, for which I am indebted to the kindness of Professor Flinders Petrie, is decidedly impure, containing only 39·4 per cent. of carbon, and a very high proportion of siliceous impurities. Its full analysis was recently brought before a meeting of the Society of Public Analysts (see *The Analyst*, 1922, **47**, September).

In view of this discovery of the existence of the mineral centuries before graphite was reputed to be known, I decided to examine early MSS. in this country, and I have to thank Bodley's librarian and Dr. Craster for giving me facilities to study similar specimens of pencil markings in the Bodleian Library. The results of my examination, which are recorded

[1] An article by the same author on *Ink Pigments in Writing* appeared in Discovery for last December. In connection with this article it is interesting to note that in the £640,000 will suit, settled on November 14 last year, Captain W. E. Foster and others successfully contended that pencilled alterations of certain documents were legal testamentary depositions.—Ed.

in a further communication to *Nature* (1922, **109**, 516), confirm the *a priori* conclusions upon the observations of Schönemann. In several MSS. of the thirteenth and fourteenth centuries ruled lines similar to those described by Schönemann are present, and in each case they are in a pigment of metallic lead or other metal. All the early pencil writing in annotations in books in the Bodleian is in a pigment of metal. Notable instances of such writing are to be found in the horn notebook of Casaubon (1613) and in the diaries of Anthony Wood (1676–85).

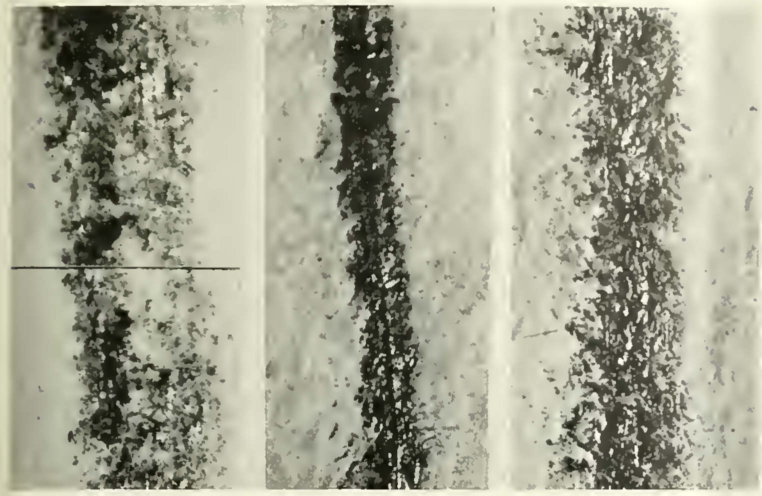


FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—MARKING MADE WITH METALLIC LEAD. Magnification 20.

FIG. 2.—MARKING MADE WITH LEAD PENCIL CONTAINING BORROWDALE GRAPHITE. Period 1831. Magnification 20.

FIG. 3.—MARKING MADE WITH PENCIL OF COMPRESSED GRAPHITE. Period 1843. Magnification 20.

Pencils of natural graphite, made by cutting the mineral into strips which were fixed in a wooden holder, produce lines which show masses of brown or black pigment, whilst in heavier strokes the fibres of the paper are lit up by the adhering particles. Occasionally particles of siliceous impurities will occur, and will produce irregular disjointed striations appearing white on the dark background of the pigment, as shown in Fig. 2.

The first occurrence noted of writing in a graphite pencil in the Bodleian Library is in a note made by Anthony Wood in *A Collection of Poems on Affairs of State* (1688). The masses of pigment are quite uniformly distributed and none of them shows the lustre or striations of the particles left by lead or other metals. The earliest instances of graphite writing discovered in the British Museum were in two notebooks of Sir Thomas Cotton, one of about 1630 to 1640, and the other 1640 to 1644. Other interesting examples in the British Museum are to be found in Hogarth's notebook, the pencil marks in which are particularly free from any siliceous striations, and in Flaxman's drawings of the early nineteenth century, which are in an exceedingly fine type of graphite.

The gradual failure of the Borrowdale graphite mines led to the adoption of various substitutes. In the first place, graphite dust was compressed into solid blocks, which were then cut up like the original mineral. Pencils made from such compressed graphite produced markings which can be readily distinguished from the natural graphite. The lines show a regularly distributed series of high lights quite different from the lighter striations due to siliceons impurities in graphite, and apparently due to distribution of pigment on the fibres of the paper.

Subsequently the process of making pencils invented in 1795 by Conté, of Paris, came into general use, and by about 1870 had practically displaced the older method.

In the modern method of pencil-making, finely powdered purified graphite is mixed with China clay in proportions varying with the hardness of the pigment required, and the mass kneaded into a paste, which is forced through small openings in a cylinder so as to produce circular threads of pigment. These are dried, heated in a covered crucible, and glued into grooves in a wooden holder. In some processes wax is forced into the finished pigment by means of pressure.

FIG. 4.—LINES MADE WITH A MODERN CHEAP COMPOSITE PENCIL.

The striations indicate the sequence of strokes. Magnification 20.

The microscopical appearance of the lines made by

these composite pencils is quite characteristic, for the particles of clay, regularly distributed throughout the mass, appear as fine silvery striations, somewhat resembling minute strings of pearls, running in fine parallel lines from end to end of the stroke.

In view of the fact that this process of making composite pencils was invented in Paris, it is interesting to note that a card written to Flaxman by the French painter Epinat, between 1805 and 1814, shows the distinctive silver striations of modern pencil pigments. This is the first occurrence noted of such markings in the MSS. Department of the British Museum.

Since the pigment after its application to paper does not undergo any appreciable alteration, it is not possible to form any estimate of the age of pencil writing by methods similar to those applicable to ink in writing. There is only one possibility upon which such a judgment may sometimes be based. If at any point two lines written with lead pencil intersect, it is usually manifest which line is uppermost, for the silver striations in that line will run without interruption from end to end, whereas those in the lower line will be broken at the point of intersection (see Fig. 4 above). Under these conditions it is possible to state which of the two lines was made first.

Apart from microscopical differences in the form and appearance of the silver striations, writing in different pencil pigments may sometimes be differentiated by chemical tests. For example, the graphite and clay used for the pigment frequently contain very varying amounts of iron or of chlorides, and the markings will then show reactions of different intensity when tested with the respective reagents. Titanium is also a common constituent of natural graphites, but only in one instance, in a modern Conté pencil, has the writer found a composite pigment to contain sufficient titanium to give a distinct reaction in the markings on paper. In that case, however, a colour test alone was sufficient to distinguish the marks made with that pencil from those made with any other pencil examined.

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NEW DISCOVERIES IN EGYPT

As we go to press the first news of what will, no doubt, prove to be the most remarkable archæological find of the century has reached this country. The discovery was made by Lord Carnarvon and Mr. Howard Carter, and has resulted from their prolonged excavations in the Valley of the Kings near Luxor, in Upper Egypt. The message to *The Times* says

[*Continued at foot of page 28.*

Belief in After Life Amongst the Greeks and Romans—I

By W. R. Halliday, B.A., B.Litt.

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SPIRITUALISM has been defined as "the belief that it is possible to communicate with spirits of the dead so as to receive from them intelligent messages and proofs of their identity and survival, and as the study and practice of so doing."[1] Traces of spiritualistic belief and practice as thus defined may be found in the records of classical antiquity, and it is also true that some of the instruments employed by some spiritualists of to-day, e.g. crystal gazing, were known to classical divination. But the ordinary procedure of the modern *séance* dates, I believe, from the experiments of the American sisters Fox in the middle of the last century, and we shall naturally look in vain for those spiritualistic theories which are adapted to, or borrowed from, the current working hypotheses of modern science and physics. Further, the present vogue of spiritualism appears to have its origin in one or more of three motives : (1) the hope of regaining personal touch with loved ones who have "passed over" ; (2) the desire to submit the hopes of personal immortality to a quasi-material test ; (3) the hope of acquiring supernatural intelligence as to the course of events past or future with the object of turning the knowledge so acquired to practical account. Of these the third is mainly the motive of classical communication with the dead ; the first two were not, I think, widely operative.

In the Homeric poems, which are the earliest literary account which we possess of a Greek society, the belief in personal survival of a certain kind is indicated. The spirit leaves the body with the breath ; it retains human shape, but is incorporeal and resembles a figure seen in a dream. There is no resurrection of the flesh. When Odysseus met the spirit of his dead mother, "thrice I sprang towards her and was minded to embrace her ; thrice she flitted from my hands as a shadow, or even as a dream, and sharp grief arose ever at my heart." In answer to his complaint, his mother's spirit explains : "Even on this wise is it with mortals when they die. For the sinews no more bind together the flesh and the bones, but the great force of burning fire abolishes these, so soon as the life hath left the white bones and the spirit like a dream flies forth and hovers near." Homeric society, of course, practised cremation.

[1] Schiller in *Hastings' Encyclopædia of Religion and Ethics*, *s.v.* "Spiritism."

Immediately after its departure from the body the spirit "hovers near" until the due performance of funeral rites enables it to join the company of the dead. During the interval between death and funeral it can revisit mortals, but not afterwards. Thus the spirit of Patroclus appears to Achilles "in all things like his living self, in stature and fair eyes and voice, and the raiment of his body was the same." It appears in a dream, but is something more than a dream, though equally insubstantial. "Achilles reached forth his hands but clasped him not; for like a vapour the spirit was gone beneath the earth with a faint shriek." But once the funeral rites are over there is a gulf fixed between living and dead. "Never more," says this apparition, "shall I come back from Hades, when ye have given me my due of fire." The ghosts seen in the vision of the second-sighted Theoclymenus in the palace of Odysseus seem to be the ghosts which the suitors are shortly to become, and not visitors from the other world.[1]

In the next world the life of spirits is a feeble replica of their life on earth, and a phantom Orion eternally pursues his phantom quarry. "Rather would I live above ground," laments the spirit of Achilles, "as the hireling of another, with a landless man who had no great livelihood, than bear sway among all the dead that be departed." The "strengthless" dead may shake the nerves of a mortal by their appearance, but they have no effective power, and are easily kept at a distance by the menace of a drawn sword. Their cry is inarticulate and feeble like the faint gibbering of bats.

Homer's Conception of the "Other World"

Our knowledge of the Homeric "other world" is mainly derived from the XIth book of the *Odyssey*, in which Odysseus journeys to its gateway beyond the outer rim of Ocean which Homer conceived as a stream completely surrounding the world in which we live. Here appropriate libations and sacrifices are carried out, and then the throats of a number of sheep are cut over a trench. The spirits flock up to drink of the blood, and each, as he is allowed to do so, becomes thereby articulate. "The blood is the life thereof," and the draught of blood thus supplies the spirits with a temporary life and enables Odysseus to converse with them with profit.

The hero's object in venturing to the gate of Hades is to obtain knowledge of the future from the spirit of Teiresias, the Theban seer. It is important, however, to notice that the powers of the spirit of Teiresias are due, not to his having "passed over," but to the prophetic gifts which he had enjoyed during life. Spirits of the dead as such have no prophetic powers. Some of them are able to tell Odysseus things which he does not know, but these are without exception memories of their experience on earth, and so far are they from possessing omniscience or supernatural knowledge of terrestrial affairs, that the spirit of Agamemnon asks Odysseus for news of his son Orestes.

Hero Worship

The spirit of Teiresias can reveal the future only because the man Teiresias had been a prophet. There are other traces in the Homeric poems of the belief that certain individuals may pass to an existence different from that of ordinary mortals after death. Menelaus was promised that he should not taste of death, but suffer translation to a Paradise which Hesiod afterwards located in the Blessed Western Isles. Cults of such personages may indeed have persisted from the Bronze Age when dead kings and chieftains were certainly the objects of worship, although there is no evidence[2] of posthumous cult at the barrows of Homeric kings. However this may be, in post-Homeric times the worship of the spirits of such outstanding individuals became popular throughout the Greek world. Many of the "heroes," as these semi-divine beings were called, were no doubt legendary persons, but in the view of their worshippers they had all once lived as mortal men. Such apotheosis after death was in fact extended to historical persons. For example, the famous Spartan general Brasidas was worshipped as a "hero" by the people of Amphipolis immediately after his death in 422 B.C. The real or supposed tomb of the hero was often, but by no means invariably, the site of his cult. Regular features of hero-worship were divination and healing, and the method normally employed was that of incubation, i.e. the inquirer or patient slept at the sacred spot and was visited during the night by the hero. It is natural that the same confusion between dream and apparition which we noticed in the episode of Patroclus' visit

[1] "Then the god-like Theoclymenus spake among them: 'Ah, wretched men, what woe is this ye suffer? Shrouded in night are your heads and your faces and your knees and kindled is the voice of wailing, and all cheeks are wet with tears and the walls and the fair main-beams of the roof are sprinkled with blood. And the porch is full, and full is the court of ghosts that hasten hellwards beneath the gloom, and the sun has perished out of the heaven and an evil mist has overspread the world.' So spake he and they all laughed sweetly at him." *Odyssey*, xx. 350 foll. Butcher and Lang draw attention in their note to the very close and detailed analogies in the recorded stories of second sight in Scotland and Scandinavia.

[2] The reader should be reminded that on Sir William Ridgeway's widely accepted explanation of the *Origin of Greek Tragedy*, set forth in his book with that title, such evidence is plainly afforded by many Greek plays notably by the *Choephorœ* ("Libation-bearers" i.e. to the tomb of Agamemnon) of Æschylus, and the *Ajax* of Sophocles – Ed.

to Achilles is a frequent feature of the communication between hero and worshipper.

This communication with a spirit which has undergone apotheosis is covered by the definition with which we started, but it will be seen that the analogy to the communication attempted by modern spiritualism is not close. Hero worship is in fact exactly analogous to something quite different—the worship of saints.

Ancestor Worship

Some "heroes" were, of course, the imaginary ancestors of their worshippers; in popular usage the word "heroes" came to be used as equivalent for spirits of the dead, and at several points hero-worship and ancestor-worship touch. Their assimilation was no doubt assisted by the growth of the practice already noticed of deifying distinguished persons immediately after their death. Amongst other less complete documents of similar character we possess the will of Epikteta, a lady of wealth and position in the island of Thera at the close of the third or the beginning of the second century B.C. She makes testamentary provision for the endowment and maintenance of a family religious association to perform in perpetuity commemorative sacrifices in honour of the spirits of her husband, her two sons, and herself. A shrine, *heroōn*, like that dedicated to a "hero" or saint, is to be maintained in their honour, and the living relatives assembled at the service are allowed to eat the meat of the sacrifice, which therefore partakes of the nature of a family sacramental meal. This is an interesting feature, emphasising, as it does, the friendly character which is, upon the whole, characteristic of the relations existing between the Greeks and Romans and their ancestral spirits. For the practice enjoined infringes the general rule of Greek religious custom, according to which a distinction was usually drawn between Olympian divinities and gods or powers connected with death, and the underworld. In sacrifices to the former the flesh of the victim was cooked, and the worshippers partook of it; sacrifices to the latter were normally holocausts in which the victim was completely consumed by fire.

The will of Epikteta belongs to an age in which the belief in personal survival was generally held, but if we may judge from the older ceremonies of Greece and Rome, it would seem that ancestor-worship does not necessarily imply a belief in the survival of personality. In early Rome, before Greek ideas had transformed the native beliefs, it seems improbable that there was any conviction of individual personal survival. At death the spirits joined the undifferentiated collective group of ancestral spirits whom the Romans called *Manes*, but there is no evidence in early times of any religious belief or ceremony directed towards an individual spirit of a dead man or ancestor. In fact the early Roman had no singular noun by which to express such a conception, and even when later the idea of personal survival had been acquired, Latin was forced to use the plural *Manes* to denote the singular spirit of an individual dead man.

Relationship between Dead and Living

I am inclined to think that in early Greece the relationship of the living to the ancestral dead may have been somewhat similar—a relationship, that is to say, between two groups rather than between individuals. At Athens an ancient festival called *Genesia* seems to have resembled the Roman *Parentalia* in general character. The object of its commemorative rites was the plural "ancestors" (γονεῖς), a collective group of spirits like the Roman *Manes*. Upon the Attic festival of All Souls, the *Anthesteria*, offerings of porridge were made to the family dead, and at its close they were bidden to depart until the following year. "Begone, spirits, it is no longer *Anthesteria*." These ceremonies, and such superstitions as the belief that the dead members of the family were present unseen at the family meal, and that food accidentally dropped upon the floor must be left undisturbed for their consumption,[1] reveal a kindly relationship as existing between dead and living. Indeed, few societies have been less ghost-ridden than the Greek.

Such ceremonies as these, concerned with the collective group of spirits of the dead, do not in themselves presuppose individual personal survival after death. The conviction of the existence of a future life in which the individual soul survived to undergo reward or punishment appeared, as we shall see, at an early date in Greece, although it came from a foreign source. It affected all subsequent religious and metaphysical speculation, and increasingly it passed into common or popular acceptance. But it may be worth while to emphasise, in conclusion of this part of my paper, the markedly social or civic attitude not only towards religion, but towards life in general, which distinguished at least the earlier Greeks and Romans from the moderns with their essentially individualistic outlook. Indeed, as long as the city state retained its full vigour and resisted the encroach-

[1] Somewhat similar was the practice at the old Prussian funeral feasts. "If any morsels fell from the table, they were left lying there for the lonely souls that had no living relations or friends to feed them. When the meal was over, the priest took a broom and swept the souls out of the house, saying: 'Dear souls, ye have eaten and drunk. Go forth, go forth.'" Frazer, *The Golden Bough*, pt. ii, *Taboo and Perils of the Soul*, p. 238.

ments of cosmopolitanism and individualism, this markedly social or political attitude towards life remained strong. What I mean by this may perhaps be illustrated by a quotation from the Funeral Speech which Thucydides represents as having been delivered by Pericles in honour of those who had fallen in the first year of the Peloponnesian War. To the bereaved he offers this consolation : " I know it is not easy to give you comfort. I know how often in the joy of others you will have reminders of what was once your own, and how men feel sorrow, not for the loss of what they have never held, but when something that has grown dear to them has been snatched away. But you must keep a brave heart in the hope of other children, those who are still of an age to bear them. For the new-comers will help you to forget the gap in your own circle and will help the city to fill up the ranks of its workers and its soldiers." *The temper of this consolation perhaps prepares us to learn that, although during the Peloponnesian War one of the psychological results of prolonged strain manifested itself in a great vogue of prophecy and of religious emotionalism in general, this did not, so far as I am aware, take the same form of a passionate hope of effecting communication with the spirits of the fallen, which has been the characteristic feature of our own time.*

(*To be continued in the February No.*)

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Festivals Celebrating Local Saints in Modern Egypt

By Winifred S. Blackman

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Owing to the fertility of its soil, Egypt, as far as the necessities of life are concerned, has always been largely self-supporting. But from the earliest times, as the ancient records show, numerous commodities were imported into the country by foreigners, or else by the more ambitious of the native merchants themselves, who ventured far afield to obtain such goods in return for their own products. The richly endowed temples would have been generous purchasers not only of home products, but also of foreign goods, such as incense, which played so important a part in the elaborate ceremonial of the daily liturgy, panther skins which were required for the fashioning of the vestments of certain priests, and sweet-smelling unguents.

Thus in Ancient Egypt, as in many other countries,[1] commerce and religion were closely associated. Such also is no less the case in Egypt at the present day, as is particularly noticeable at the *mūlids*, or annual festivals of the local sheikhs or saints.

The Mūlid en-Nebi, the annual celebration of the birthday of the Prophet, ranks, of course, as the most important of such festivals among the Mohammedan section of the population. However, in this article I shall content myself with a description of three *mūlids* in honour of local village saints, which I myself attended during my stay in the more unfrequented parts of Egypt last winter.

Each village has its local sheikh, whose dome-shaped tomb forms its most prominent architectural feature, rising up among the crowded hovels of the *fellāḥīn* (peasants), or standing on the highest point of the adjacent burial-ground. Sometimes a village can lay claim to two or more sheikhs.[2]

The *mūlids*, at which I was present, took place at El-Lahūn and Dimishkīn in Fayūm Province, and at Manial in the province of Beni Suēf.

Festival at El-Lahūn

I propose to describe them in the order of their occurrence, the first being that held at El-Lahūn in honour of the Sheikh Umbārak, whose tomb stands in an old disused burial-ground situated on the outskirts of the village (Fig. 1). The whitewashed walls of this tomb are decorated outside with pictures descriptive of the pilgrimage to Mecca, roughly sketched in red and blue paint. Around the dome are small, what one might almost call clerestory windows, in each of which a lighted candle is placed every night. The light afforded by this illumination is a welcome break in the surrounding darkness to the traveller, who, returning home after night has fallen, has to pick his way through refuse-heaps, piles of stones or mud—the invariable obstacles to one's progress along the narrow, tortuous lanes of an Egyptian village.

[1] Cf. Robertson Smith, *The Religion of the Semites*, p. 461. London, 1907.

[2] The word *sheikh* means literally an old man. It also signifies the head of a tribe, the leading man in a village, a learned man (i.e., one learned in the sacred writings), and a holy man or saint, living or dead.

The *mūlid* of the Sheikh Umbārak began at 2 p.m. on April 14, on the morning of which day similar festivities were inaugurated in certain neighbouring villages in honour of their own particular sheikhs. A large crowd collected in the vicinity of the sheikh's tomb, several people, chiefly women, seating themselves around it on the outside. A blind woman, "the servant of the sheikh," was receiving donations from the faithful on his behalf. As the donors presented their gifts, they recited the *fatḥah* (the opening chapter of the Ḳur'ān) in low and rapid tones. In the road which ran past the burial-ground, and in the adjacent

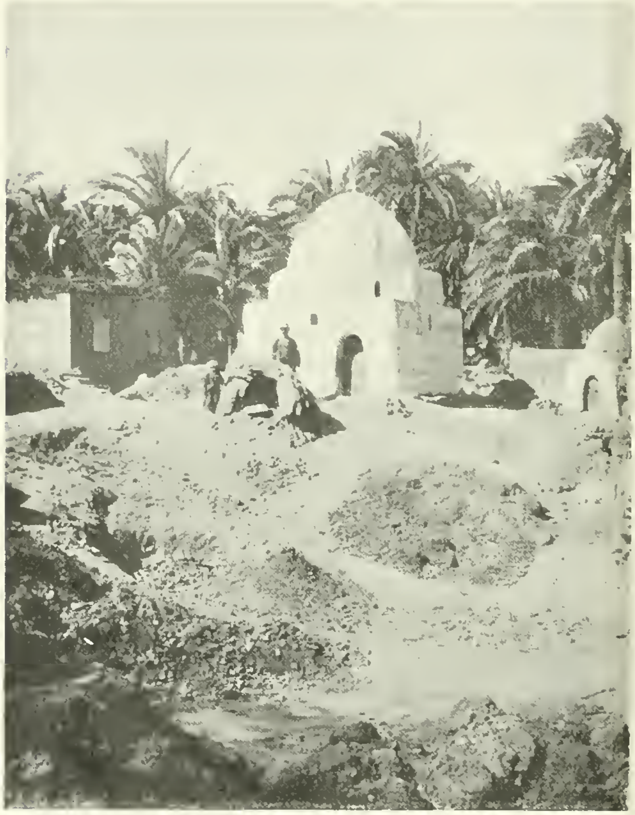

Fig. 1.—The tomb of the Sheikh Umbārak at El-Lahūn.

palm-grove, large crowds of people were enjoying themselves, and along the roadside booths had been erected wherein butchers, and vendors of sweetmeats, toys and other wares, plied their trade, to all appearance doing excellent business.

Games with Coloured Eggs

Eggs, dyed a bright cerise, are a special feature of all these *mūlids*, and those who sold them attracted a considerable number of customers. These coloured eggs are used for two games, which are played as follows. In one of them two boys or men take part, each grasping an egg in his hand. One of them knocks his egg against that of his opponent, and the man whose egg is not cracked is regarded as the winner and takes the cracked egg of his adversary. In the other game several eggs are arranged in a row on the ground, and a number of men sit at a certain distance away from them. Each in turn rolls an egg towards the row of eggs facing him, and the man who first succeeds in cracking one of them wins the lot. These games, which were played by large numbers of people at all the *mūlids* that I witnessed, are an interesting study for the anthropologist, coloured eggs being used for games, in many cases similar to these, in various parts of Europe, especially in the Balkan States. Again, in most of the northern counties of England coloured eggs are still used in a game which is played on Easter Monday, and which closely resembles the second Egyptian game described above. I remember being presented, when a very small child, with one such egg which was dyed a deep purple.

Other attractions were not lacking at this *mūlid* of the Sheikh Umbārak. In the palm-grove, a conjuror in one part and a poet in the other had collected large and interested audiences. The poet was accompanied in his recitations by a woman, and sometimes by two or three men as well, she and they each beating a single-membrane drum. Peep-shows also contributed to the amusements, the pictures shown usually representing favourite national saints, and heroes and heroines. Lastly, roughly made little cars hung on wheels, which turned round and round, were much patronised by the children.

The intense heat, the swarms of flies, and the dust kicked up by the excited pleasure-seekers, all contributed to the general discomfort of a mere English spectator like myself! However, the friendly welcome I received wherever I went more than compensated for these evils.

A special sheikh (i.e. a holy man of this district), who would later on conduct the *zikr* in honour of the sainted Umbārak, paraded through the crowd on a donkey, preceded by three men carrying large banners decorated with various designs and inscriptions, and by musicians playing on cymbals and a double-membrane drum. The same banners are used at the *mūlids* of other sheikhs at some of the neighbouring villages, and are kept, when not in use, in the house of "the servant" of the Sheikh Ṭayyib at Hawāra. The men who carry them advance with dancing steps instead of an ordinary walk.[1]

The festival was conducted with the utmost good humour, the behaviour of the crowd being perfect. It came to an end at 7 p.m., when the gaily dressed little girls, their mothers, fathers, and brothers,

[1] A similar ceremonial gait was a feature of certain ancient Egyptian religious performances, for which see Hermann Kees, *Der Opfertanz des ägyptischen Königs*, Leipzig, 1912.

retired to their homes to rest and to discuss the pleasures of the day.

Festival at Manial

On the following day the annual *mūlid* of the Sheikh Ṣabr was celebrated at Manial, a small village picturesquely situated on the bank of the Bahr el-Yūsuf.

At one end of the village stands a large tree of considerable age, said to mark the resting-place of the sheikh, though perhaps originally there was a domed tomb as well, which has now disappeared. However, the sheikh is at the present time definitely associated with the tree. I noticed that several large nails had been driven into the trunk, many of them having human hair twisted round them, the hair varying in colour from very fair to dark brown. These nails are hammered into the tree by a suppliant, when he or she makes a request to the sheikh. Thus a man or woman suffering from headache or other ailments will come to the tree, offer up a petition for recovery, knock a nail into the trunk, and then often twist round the nail some of his or her hair; a cure being, it is supposed, sure to follow this procedure. Childless women also visit the sacred tree in order to be cured of their barrenness. The Sheikh Ṣabr is much venerated, not only by the inhabitants of his own village, but also by those of the surrounding villages. He is looked upon as a very good man and as most benevolent to those who seek his aid.

A Religious Dance and other Features of this Festival

In view of the veneration paid to this sheikh, a very large crowd had assembled in the neighbourhood of his tree by the time that I arrived on the scene—some time before noon. As I rode on my way to the village through the cultivation, I passed a number of people, both old and young, on their way to the festival. When I joined the crowd I found the usual brisk trade going on, some of the vendors of wares having erected rough booths, under which they could take shelter from the fierce rays of the sun. Toys, cheap ornaments, brilliantly coloured sweetmeats, and other delicacies, were being eagerly purchased. A fairly large *zikr* was taking place under the shade of the branches of the sacred tree. It was executed by a number of men forming a circle round a sheikh who conducted this religious exercise. The men swayed rhythmically from side to side, nodded their heads, or bent backwards and forwards, as they pronounced over and over again the name of Allāh. The presiding sheikh beat time by clapping his hands, while now and then a *fiḳīh* would chant passages from the Ḳur'ān. The whole ceremony was conducted with great earnestness and solemnity. Close to where this religious performance was taking place was to be found the usual large wheel, with its hanging seats, where the children congregated in large numbers, all clamouring for a ride, as they are to be seen doing about the whirligigs provided at the big fairs in England. At another spot a poet had collected a large audience, that listened with evident enjoyment while he recited to the accompanying beats of two tambourines and a shallow, single-membrane drum. He was the same poet who had attended the *mūlid* at El-Lahūn. The banners were much in evidence at this festival, and I managed to secure a good photograph of them and their bearers as they stood grouped together under the sheikh's tree, along with a few musicians, and the inevitable crowd (Fig. 2).

Having been most hospitably entertained by the

Fig. 2.—Banners of the Sheikh at Manial, under the Sacred Tree.

'*omdah* of the village, and the festival having come to an end, I returned to El-Lahūn, passing, as I rode along, the sacred banners, which were being carried back by a party of boys to their resting place at Hawāra.

Festival at Dimishkīn

The third *mūlid* at which I was present, namely, that celebrated at Dimishkīn, took place on Friday, April 21. As this village lies a considerable distance from El-Lahūn, I started fairly early in the morning, riding in company with a goodly number of people. The regular starting-off point was the little railway station at El-Lahūn, where several primitive-looking vehicles were waiting to convey the would-be visitors to the *mūlid*. The children, as is customary, were decked out in their brightest and best clothes, and several of them, along with some women, were closely

packed together in one or two of the clumsy, jolting carts. Many people, however, denied themselves such a luxury as a conveyance, and started off on foot, heedless of the discomforts inevitably attendant upon the south wind that was then blowing—blasts almost as hot as those issuing from the mouth of a furnace, clouds of fine suffocating dust, and swarms of flies. I passed a number of these optimistic pedestrians as I rode along on my donkey, some of them being women carrying their babies.

On arriving at Dimishkīn I found a large crowd

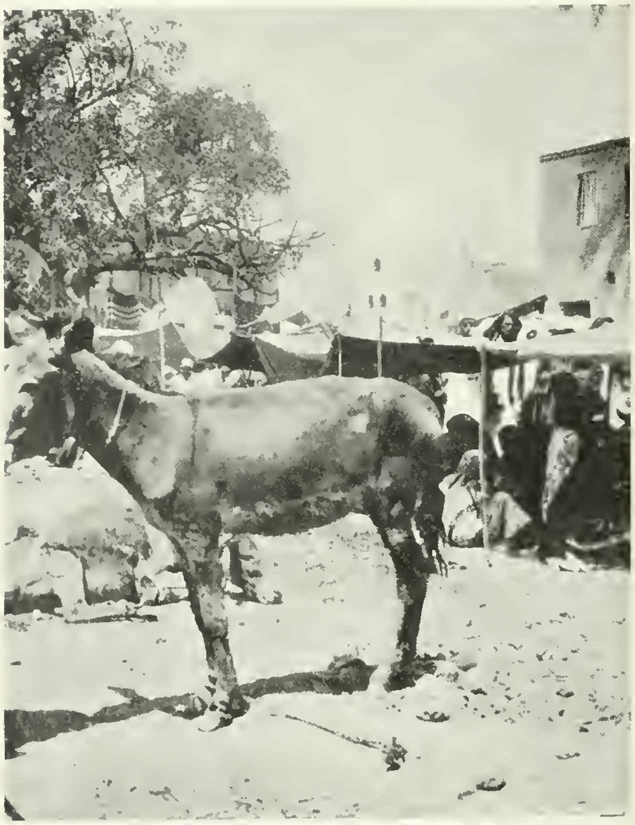

Fig. 3.—*MŪLID* AT DIMISHKĪN, WITH THE SHEIKH'S TOMB AND TREE ASSOCIATED WITH IT.

assembled around the tomb of the Sheikh Farrāsh en-Nebi, whose *mūlid* was being celebrated. This tomb was situated close to the village, and, as usual, a large tree [1] was associated with it, booths being set up under the shade of its wide-spreading branches (Fig. 3). Here again a large *zikr* was in progress, those taking part in it having secured themselves a sheltered position near the tree. At some distance from the tomb was a concourse of people, all intent on playing the games with the coloured eggs. The same poet officiated at this *mūlid* as at the two former festivals, the same brisk trade was going on, and the crowds also showed the same good-natured enjoyment.

Origin of *Mūlids*

It is probable that such festivals, which take place at various dates all over Egypt, can claim a very ancient ancestry. In quite early times there were festivals, celebrated at stated seasons, in honour of the various local divinities, and in celebration of certain calendar events, that attracted considerable crowds. Moreover, as at the modern *mūlids*, there was a good deal of brisk trafficking carried on in conjunction with the religious performances, merchants coming from considerable distances, by boat or caravan, laden with their wares, which found ready purchasers among the assembled crowds. An inscription in the great temple of Denderah describes such a festival in the following terms: "The gods of heaven shout for joy, shout for joy . . . The Ḥatḥors [i.e. the dancing girls impersonating that goddess] beat their tambourines [more accurately "single-membrane drums"] the August Ladies wear their *menit*-collars. Those who are gathered together in Denderah are drunk with wine and garlands of flowers are on their heads. The sailor-folk of Edfu [i.e. the crews of the boats that have come from that town] walk joyously about, being anointed with the finest unguent. All the children rejoice, making jubilation for the Golden One (Ḥatḥor), from the rising to the setting of the sun." [2]

In one respect the modern Egyptians are certainly superior to their ancestors, for I never saw a single case of drunkenness or bad behaviour at any of the three *mūlids* at which I was present.

Mūlids and English Fairs

The modern *mūlids*, as also their ancient prototypes, show striking resemblances to our own English fairs, especially as celebrated during the Middle Ages and on into the seventeenth century—these being associated in every case with a saint and also with trading. Our modern fairs, though often still named after the saints in whose honour they were originally held, have now lost their religious significance. But one which I attended after my return to England reminded me in many ways of the *mūlids* which I had recently witnessed just before my departure from Egypt.

[1] Similarly in ancient times a tree or grove of trees was attached to the various tombs which were supposed to contain a portion of the body of Osiris. See, e.g., H. Schäfer, *Das Osirisgrab von Abydos und der Baum* pḳr. in *Zeitschrift für ägyptische Sprache*, vol. xli, pp. 107–10; Junker, *Das Götterdekret uber das Abaton*, Wien, 1913, pp. 12 ff., 50 ff.

[2] *Duemichen, Altägyptische Tempelinschriften.* Leipzig, 1867. Pl. xxxviii, lines 16–19.

Insulin and the Gland Treatment of Diseases

By R. J. V. Pulvertaft, B.A.

THERE are fashions in medicine at least as transient, as varied, and as emphatic as in feminine clothing. We have passed through the age of "humours," when the body was supposed to be at the mercy of vague warring influences, which swayed it hither and thither; we are now in the hey-day of the gland theory; the old "humours" are to-day called "hormones," or "excitants," and we are well content with the new name. But behind the large amount of absurd speculation which fills the advertising pages of medical papers, there is a great deal of valuable truth. "Insulin," the new substance which is used in the treatment of that fatal disease, diabetes, is the latest production of this age's medical fashion—untried, to any large extent, as yet. And, while we bear in mind that there is such a thing as transatlantic optimism, it appears that much may be expected from it.

A French scientist, Brown-Séquard, in 1891, was the first to use extracts of animal glands to treat bodily ailments. He employed preparations of the sex glands of dogs to ward off old age in men. Metschnikoff, a Russian scientist, welcomed this notion as the promise of eternal life, when combined with a wise discretion in diet and a devotion to sour milk! Perversely, we still die; we "grow old as doth a garment." But Brown-Séquard grasped the idea that the blood in flowing through an organ might be so changed that it would affect other organs. The new substance so produced was called in 1902 by Bayliss and Starling, two contemporary English physiologists, a "hormone." The field has widened ever since; to-day we may, as a recent writer has ironically pointed out, eat like Alice in Wonderland of one gland-mushroom and be a giant, of another and be a dwarf.

The *pancreas*, a digestive gland, is one organ capable of so altering the blood that it produces far-reaching effects on the chemistry of the body. We argue this from the effect of disease of the *pancreas* in causing diabetes; and from the production of diabetes in dogs on removing this gland or destroying certain parts of it. But the argument that extract of *pancreas* would cure this disease is not necessarily valid, for in a disease which follows on destruction of another gland, the *suprarenal*, glandular extracts have proved very disappointing.

However, there is one well-known case where gland-extracts certainly improve conditions—a certain type of dwarfish idiot known as a cretin is greatly improved physically and mentally by being fed with thyroid gland from the neck of a sheep. And there are certainly many abnormal conditions of growth which depend on the workings of a small gland near the brain, called the *pituitary*. Charles Byrne, the Irish giant, whose skeleton is preserved in the museum of the Royal College of Surgeons, was an extreme example of an over-secretion of a part of this gland, associated with a gigantic stature; the fat boy of Peckham owed his girth to its diminished activity; and perhaps Hop o' My Thumb of the fairy-tale was one of a group of tiny miniature men, whose stunted growth is attributed to destruction of the pituitary gland.

The truth underlying the gland-treatment of diseases would appear to be that our body must be considered as a whole. There is a balance between the workings of one organ and another; by the blood-stream and by the nervous machinery of the body a due proportion is preserved. If a gland is for practical purposes absent, as in the dwarfish idiot alluded to, gland-extracts are of service. But when a disease attacks the body, it is no simple matter to discover where the real trouble is; the changes in the *pancreas* may be only a sign of the wider and more obscure changes in diabetes. Up to the present, extracts of *pancreas* have not brought more than transient relief; it remains to be seen whether the new and more stable "Insulin" will prove to be efficient.

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Between the Covers

WATER-POWER IN THE BRITISH EMPIRE

IN November 1917 a Committee was formed by the Conjoint Board of Scientific Studies to investigate the resources of the British Empire for the production of hydraulic power. Subsequently a Board of Trade Committee considered the water-power of the United Kingdom. The reports of both Committees have now been published, and in his preface to *Water-Power in the British Empire*, a collection of the reports of the first-mentioned Committee (Constable & Co., Ltd., 3*s.* 6*d.*), Sir Dugald Clerk, K.B.E., F.R.S., Chairman of the Committee, and also a member of the second Committee, is able to give a most interesting outline of the present position. "The coal position of the world must deteriorate from decade to decade," and the obvious substitute for coal and oil is water-power.

"The world," writes Sir Dugald Clerk, "may be

considered as a huge solar engine, in which the waters of the seas are evaporated by the heat absorbed, and much of the vapour carried to high levels, at which it is deposited as water, and flows down to the sea By this process we get a complete cycle of operations, including evaporation of water into steam, condensation of the steam into water, evaporation again, and so on. In falling from the high level to the low level of the sea, power can be obtained from this water. Hydraulic power, in fact, is a form of sun-power, and will continue in existence long after all the coal and oil in the world have been exhausted. Coal and oil have also been produced by the action of the great solar engine, and they contain a portion of the energy of radiation of past ages, stored up in the growing wood and leaves of plants, accumulations which are now being rapidly drawn upon by mankind. Coal and oil are thus the result of past radiant energy, while wind and water power are due to present radiant energy. In one case the store in the earth is being used up and cannot be replaced ; in the other case, so long as the solar system lasts, power exists also."

Approximately speaking, a total of 1,350,000 h.p. could be obtained from water in the United Kingdom. This total does not include the power available by harnessing the Severn Channel. On this subject the Board of Trade Committee in its report of December 1920 concluded that, "while insufficient data are available to enable a definite opinion as to the economic practicability of the scheme to be expressed, it merits further detailed investigation. It offers a possibility of an output of some 350,000 h.p. daily over a ten-hour working period, corresponding to a saving of 1,270,000 tons of coal per annum on the basis of the consumption in modern large coal-fired power stations."

"The largest installation as yet developed in the United Kingdom is the Kinlochlever Works of the British Aluminium Co. Although the drainage area is only 55 square miles, the high rainfall, amounting to 70 inches per annum, and the large fall of 920 feet, are sufficient to give an output of about 30,000 e.h.p. These works are now being increased by the addition of the power to be obtained from Loch Eilde Mor."

Of the 15,000,000 or 16,000,000 h.p. produced by water-power throughout the world, "it is striking," says Sir Dugald Clerk, "to find that Continental Europe uses water for 27 per cent. of her total motive power, and the United States 24 per cent., while the United Kingdom only used 0·6 per cent. Our Colonies, however, use water at present for 33 per cent. of their total industrial power."

As to the total available amount of hydraulic horse-power throughout the British Empire, "Canada has nearly 27,000,000 hydraulic h.p. available, and when India, New Guinea, and New Zealand are added we attain a potential power of the order of 40,000,000 When we add to this the water resources of East, South, and Central Africa, Egypt, Ceylon, Tasmania, Australia, British Guiana, Burma, the Malay States, and our own Islands, the aggregate hydraulic power of the Empire approaches 70,000,000 continuous h.p. a truly remarkable power to be used in the present to a small extent and in the future to a very large extent as coal resources become reduced."

WHAT IS A GOOD MEMORY ?

"A GOOD memory should obviously be exact. An experience should be recalled without the loss of any characteristic details and—which is just as important—without the gain of any foreign ones. Probably few persons realise how common is the latter event. In recounting a funny experience which has happened to themselves most people are apt not only to drop the unamusing details, but to trim the edges of the focal events so that they dovetail perfectly into each other.

"Since complete recall of any experience is impossible, a good memory should be serviceably selective. To good remembering, as to good art, leaving out the right things is indispensable. The art of forgetting is but the inner aspect of the art of remembering."—Prof. T. H. Pear in *Remembering and Forgetting*. (Methuen & Co., Ltd., London., 7*s* 6*d*.)

WHERE RABBITS SPEND THE DAY

"IF you were to ask one thousand men in any town, or part of the country for that matter, where rabbits spend the day, nine hundred and ninety-nine of them would answer : 'In burrows or holes in rocks, of course,' unconscious of the fact that some rabbits never go near a hole of any sort or kind unless forced there by a dangerous enemy. Many rabbits that live in woods sit out all day long wet or fine, and keepers profess an ability to distinguish them from burrow dwellers by the darker tint of the fur along their backs.

"At certain seasons of the year burrow dwellers will make a nice cosy 'seat' in some rough tussock of grass, and if left undisturbed spend the whole day in it. I have watched rabbits go to their 'seats' in the early hours of the morning on many occasions, but did not know until quite recently that they will sometimes do so, even in the late afternoon.

"Crossing a hill after a heavy shower of snow that had fallen between two and three o'clock one day, I noticed that a rabbit had left a wood immediately on my right, and hopped quite leisurely, as the character of its footprints indicated, out into the rough grass field through which I was passing. Expecting to discover its returning tracks a little farther down I walked on, but was disappointed. Returning to the

point at which the animal had emerged from the wood, I followed its footmarks until I came upon it squatting in a nice cosy 'seat' under a bush. There were plenty of good burrows in the field it could have taken to for safety, supposing it had been driven out of the wood by a pursuing enemy, but the fact that it had entered the field in quite an unperturbed state of mind, and had not attempted to go near any hole or burrow, entirely mystified me as to why it should be going to rest at such a peculiar hour of the day."—Richard Kearton, F.Z.S., in *At Home with Wild Nature.* (Cassell & Co., 7*s.* 6*d.*)

Railway Electrification

By S. R. Roget, M.A., A.M.I.E.E.

The "electrification" of railways, or as some engineers prefer to call it, the conversion of railways to electric traction, is a matter which is receiving more and more attention in all parts of the world. Its progress was considerably retarded by the war and the conditions induced thereby, but there are, at the same time, in these conditions themselves features which increase its advantages and may render the adoption of electric traction on the railways of the world ultimately more universal, even if somewhat delayed. Before discussing this present-day aspect of the problem, however, it may be of interest to look back a little into the nature of the technical problems which have been faced, the systems which have been developed to meet them, and the directions in which practice is pointing to the future.

Broadly speaking, electric traction comprises any system in which an electric motor propels a vehicle by driving its wheels, or otherwise exerts a force to move it. The current which provides energy for the purpose may be supplied from a stationary source or from one moving with the vehicle. On electric railways the source of energy is usually a fixed generating station whose power is provided by steam turbines, engines, or other prime movers, or by water-power, the motors being carried on the train; for it is not practicable to drive trains by storage batteries, nor is haulage by fixed electrically driven machinery suitable except for such special cases as short mountain lines carrying comparatively light loads.

Tramways

The very earliest examples of electric traction were experimental, and out of them grew the familiar electric tramway. In the typical electric tramway, two electric motors on each car, mounted on the underframes or bogies, drive the axles through gearing, and continuous current (i.e. current always flowing in the same direction) is supplied from an overhead wire by a "trolley" or other contact device, and returns to the generating station through the running rails and the earth. The system is satisfactory from a technical point of view. One of the principal troubles experienced was in connection with the return current through the earth. As the rails were not insulated, the return current sometimes wandered through the ground and, passing through any buried pipes or other metal-work on its way, caused serious corrosion by electro-chemical action. Means were, however, found to keep the return current within reasonable bounds through limiting the pressure which could exist between rail and earth by introducing a few volts in the opposite direction by an auxiliary apparatus known as a "booster" in the station. In very exceptional cases the earth return has been abandoned and two overhead wires employed, notably in the case of certain lines near Greenwich Observatory where the stray return currents would be liable to interfere with observations of terrestrial magnetism.

Development of Electric Railways

The earlier and many of the present electric railways, whether formerly worked by steam or not, are in their essentials practically enlarged electric tramways. Naturally this increase in scale introduced various special conditions which brought about modifications and developments. It is a far cry from the single car with its comparatively simple controller, by which the driver regulated the supply of current to the motors, to the large passenger motor-coach, any number of which can be joined together, with or without other motorless coaches, to form a train. In some cases, particularly where old steam rolling stock or through trains running on to steam-worked lines have to be handled, or in goods traffic, or on long-distance lines worked at high pressures, electric locomotives upon which all the electrical apparatus is concentrated are preferable, and here the departure from tramway practice is most complete.

Various Systems of Current Supply to the Trains

The increased powers and distances dealt with also made it advisable to take advantage of the economy in transmission presented by "alternating" currents (i.e. currents which change their direction many times a second) owing to the ease with which such can be generated at, or "transformed" up to, high pressures; for the higher the pressure, the smaller is the current required to convey a given quantity of energy. This system, however, requires a number of sub-stations at

points along the line to convert the current to continuous current at a pressure suitable for the trains, if the advantages of continuous-current motors, in the power they will develop over a wide range of speed, are to be retained. These sub-stations entail running machinery, and the cost of their equipment, maintenance, and operation is a considerable matter to be reckoned with. The use of alternating current transmission and converting sub-stations is not limited to heavy railways, but is employed in some of the larger tramway systems such as the London County Council's.

At the voltages necessary for the ordinary continuous-current traction motor of the days we are speaking of, an overhead conductor for working heavy trains would have been of unwieldy size, so the insulated "live" conductor rail along the track was used instead. The system was thus arrived at which became practically standard for urban, suburban, and what is sometimes called interurban working, where the traffic is dense enough to justify the cost of numerous sub-stations. In London, for instance, the great power house at Lots Road, Chelsea, supplies alternating (three-phase) current at 11,000 volts to a large number of sub-stations distributed all over the London area, where it is converted to continuous current at about 600 volts, at which pressure it is supplied to the conductor rails and picked up by the trains. In this way Lots Road runs the District Railway, nearly the whole of the Tube Railways, and a small portion of the London United Tramways. A similar system is used by the Metropolitan, Great Western, London and North Western, London and South Western Railways for their suburban lines, and is employed for many lines of like nature in other countries.

For long distance and less dense traffic, however, the cost of these converting sub-stations is a very serious item. One way in which the problem has been solved is by using alternating currents throughout, because such currents can be changed in pressure or transformed without running machinery. This enables much higher contact-line pressures to be used with correspondingly lower currents for which overhead conductors are again suitable. The most widely used alternating-current traction system is that known as "single-phase," in which a simple alternating current requires only one overhead wire, and an earth return. The motors for this system were developed later than the continuous-current railway motor and are somewhat similar, although they are controlled rather differently, and in some ways are not so satisfactory. The single-phase system is considered by many to be

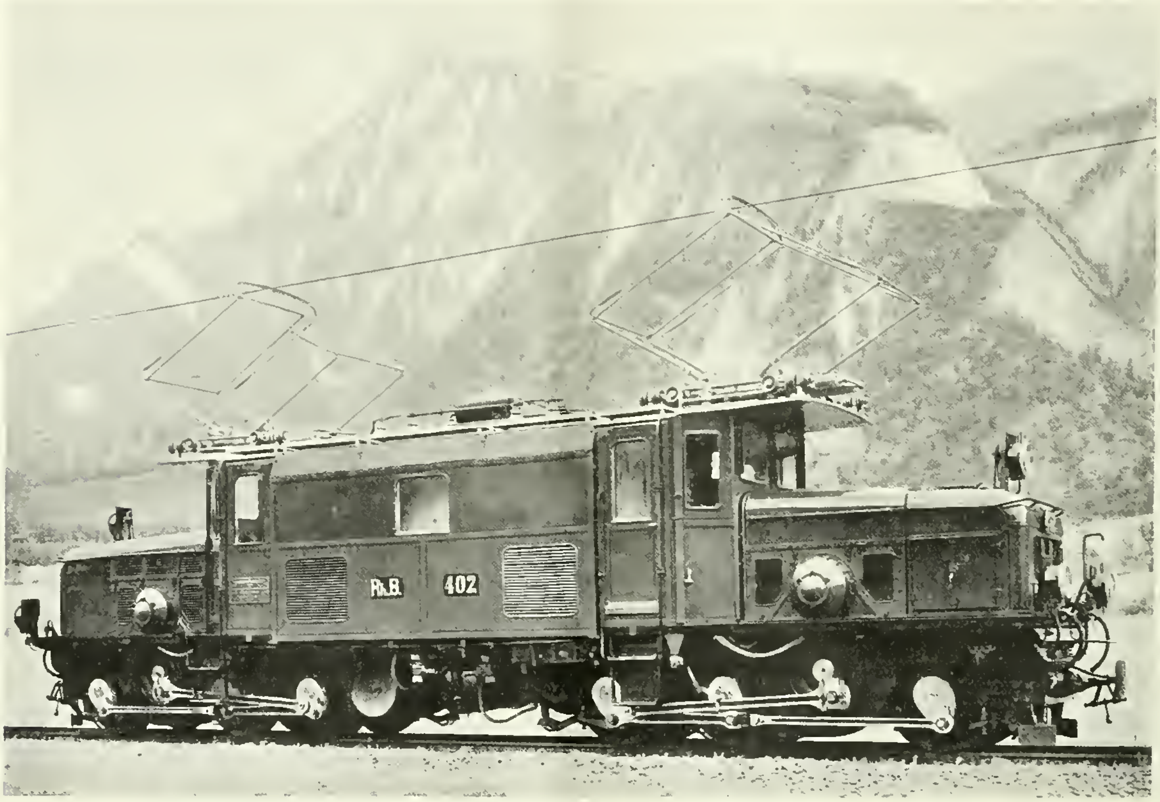

FIG. 1.—NEW SINGLE-PHASE LOCOMOTIVE FOR THE RHÆTIAN RAILWAY, SWITZERLAND.

good, especially for main lines, and is at present in use on the London, Brighton and South Coast Railway, where the system was adopted with a view to the ultimate conversion of the whole system after the suburban sections had been electrified. On the Brighton railway the overhead line pressure is 1,500 volts, but on the Continent, where longer distances and sparser traffic are the rule, the pressure used is in some cases ten times this amount. 15,000 volts is the pressure used on the main lines of the Swiss Federal Railways, the whole of which are being gradually converted to electric traction.

As an example of up-to-date practice in the field of single-phase traction, we are able, through the courtesy of Messrs. Brown, Boveri & Co., Ltd., to illustrate in Fig. 1 one of a group of single-phase locomotives which they have supplied to the Rhætian Railway in Switzerland, a narrow gauge line of severe gradients and curves including the lines connecting Coire and Dissentis with St. Moritz, Davos, etc., on the whole of which electric traction will shortly be used exclusively. This locomotive comprises two trucks, each driven by one large motor mounted on the main frame and geared to a countershaft from which a flexible drive to the wheels is obtained by outside connecting and coupling rods—a system of drive much favoured in Continental locomotives. To give an idea of size, it may be mentioned that the overall length is about 43 ft., and the total weight about 66 tons, of which about 28 tons consist of electrical equipment. The overhead line pressure varies from 7,500 to 11,000 volts, and the motors are fed from a single transformer on the locomotive at pressures up to 520 volts. The two motors, together capable of 950 h.p. continuously, or 1,140 h.p. for one hour, can give a maximum drawing effort of 13 tons at starting and a maximum speed of 28 miles per hour. The motors are kept cool by forced ventilation.

There is one further system of alternating-current traction which was used before the single-phase traction motor was developed. This is the "three-phase" system, which requires two overhead contact lines as well as the earth return, to provide for the currents. Such three-phase current permits of the use of a class of motor, known as the induction motor, which is in many respects simpler than the continuous-current or the single-phase commutator motor. This advantage of simplicity and robust construction is counterbalanced by the fact that it cannot conveniently exert so great a pull at starting and cannot give power above a certain fixed speed called the "synchronous" speed, depending upon the frequency of the alternations of the current. This last feature, however, is a very great advantage for certain cases, such as mountain lines, because if an induction motor be driven above its synchronous speed, say when the train is running down hill, it automatically becomes a generator which, like a brake, limits the speed of descent to a few per cent. above that corresponding to its synchronous speed, but without wasting power in heat like a mechanical brake, as the energy developed is returned into the line. This regenerative braking effect, as it is called, renders the three-phase system excellent for mountain lines, be they of the adhesion or rack type, and in no other system can locomotives be built with so low a weight per horse-power. This system was first used on the mountain lines in Switzerland and has extended to some of the main lines of northern Italy, where steep gradients are plentiful. It is in use on the line approaching and passing through the Simplon tunnel. For ordinary railway work, however, the three-phase motor has disadvantages in that speed regulation below the maximum speed presents difficulties, because such a motor, even with the most complicated control gear, will only run economically at a few submultiples of its synchronous speed. It will be remembered that the three-phase system was at one time seriously proposed for the Metropolitan Railway, and it was only after an arbitration that uniformity of system with the District Railway was attained.

Recently a system has been developed to combine the advantages of single-phase, single-wire distribution with three-phase motors, by employing an apparatus which changes one kind of current to the other on the train, but the system is more or less experimental at present, and would appear to suffer the disabilities in speed regulation already mentioned. In the earlier days of single-phase working advantage was taken of the fact that the single-phase commutator motor could be made to run also on continuous-current circuits, so that the same motors could run in country zones on a single-phase circuit and in urban areas as continuous-current motors. But this compromise was not a happy one, since a motor that is well designed for one kind of current is badly designed for the other.

Although the single-phase system is very suitable for main-line working, and is adopted as the standard for the purpose in Central Europe, it cannot be affirmed that the single-phase motor is as good for use on ordinary railway lines as the continuous-current motor. The equipment to be carried on the train with its transformers, etc., is heavier for its power than the continuous-current apparatus. And in all alternating-current systems there are difficulties in avoiding interference with neighbouring telegraph and telephone circuits.

High-pressure Continuous Currents

Meanwhile improvements in design made both on the continuous-current traction motor and on sub-

station equipment has somewhat upset the balance in the advantages of the systems that we have been discussing. It is now possible to employ contact line pressures up to 3,000 or even 5,000 volts. This system is in use in this country on the Manchester-Bury line of the Lancashire and Yorkshire Railway, and on the Shildon-Newport line of the North Eastern Railway. The same system working at 2,400 and 3,000 volts is also in use in America and elsewhere.

The high-tension continuous-current system is consequently now a formidable competitor of the single-phase system, and the near future should see great extensions in its use. It has already been adopted as the standard for extensions of electric railway working in France, and is being used for important schemes in South Africa and elsewhere. The high line pressure enables the number of sub-stations to be reduced, and recent developments of automatic switch gear enable these to run without continuous attention. The converting sets in any particular sub-station are started up automatically as the line requires power in the section in question, and are stopped when no longer required, their control being effected by the variations in the pressure in the line according to the demand upon it. By this means, not only are labour costs substantially reduced, but greater economy in working is secured.

Standardisation of one System Unlikely

Although standardisation of system is an ideal worthy of sacrifice to attain, every system is worth examination on its own merits. There is no " best " system in every circumstance. In different countries the opinions of experts differ. As said before, the three-phase system appears to suit the conditions in northern Italy, for the Italian engineers still remain true to it, while the single-phase system is being actively extended in Switzerland, and has been accepted as the standard in Germany, Norway, and Sweden. On the other hand, in France, America, and in various parts of the British Empire the high-tension continuous-current system is making rapid headway.

A good example of modern American practice in this direction is presented by the 3,000-volt continuous-current locomotive recently built for the mountain sections of the Chicago, Milwaukee, and St. Paul Railway by the General Electric Company (of America), which is illustrated in Fig. 2 (reproduced from a photograph kindly supplied by the British Thomson-Houston Co., Ltd.). This locomotive is 76 ft. in length overall, and has no less than fourteen axles. The total weight is 265 tons, of which 229 tons are borne by the twelve pairs of driving wheels. The motors are arranged to be used three, four, six, or twelve in series on the 3,000-volt circuit. They can develop 2,760 h.p. continuously, or much more for short periods, and the locomotive, which is designed to pull a load of 900 tons at 25 miles an hour up a 2 per cent. gradient, and can exert a drawing force up to 56,500 lb. There are a number of interesting points about their mechanical as well as their electrical design which render locomotives of this class suitable for high speeds, at which they can travel with an efficiency and steadiness exceeding that of geared locomotives of approximately this size.

In Northern Italy, where conditions are peculiarly suitable for the electrification of railways owing to the ample water-power available in a mountainous district, Messrs. Brown, Boveri & Co. have recently supplied a locomotive for use on the line from Turin to Ceres, which, contrary to the recent preference in Italy for three-phase working, has been equipped for continuous current at a maximum line pressure of 4,000 volts, and is supplied through a single sub-station for the whole 26 miles. Each motor is rated at 140 h.p. for one hour, and the locomotive is capable of a maximum tractive effort of about 9·3 tons and a maximum speed of 40·5 miles per hour.

The extent to which railway electrification is already an accomplished fact may be gathered from the following figures of the route mileage of main lines in different countries already worked electrically, or actually in process of conversion: United States, 1,522 miles; Austria, 489 miles; Italy, 466 miles; Switzerland, 462 miles; and Sweden, 272 miles.

Advantages of Electrification

Speaking generally, and assuming that the most suitable system has been chosen to meet the particular circumstances, the advantages to be gained by the substitution of electric for steam traction are: (1) increased available average speed of trains; (2) increased carrying capacity of the lines and greater economy in fuel consumption per train-mile; and (3) the great advantages of cleanliness in tunnels and in urban areas. These advantages are really those inherent upon power centralisation, but there are other advantages, due to the simplicity and reliability of electrical apparatus, which bring with them a reduction of maintenance and operating costs as compared with the steam locomotive. The increased carrying capacity is mainly due to the much greater accelerating power obtainable because an electric train has all the resources of a large station at its disposal, while a locomotive has only its own. It is this increased acceleration which is of such great value in heavy suburban traffic, where the advantages of electric traction with modern systems of

electric automatic signalling and train control are now undisputed.

For lines of longer distances and less dense traffic, this feature, although still present, does not dominate the situation in the same way. Centralisation in a power house enables fuel to be burnt with an economy unapproachable in the furnace of an isolated locomotive, and presents opportunities for utilisation of other sources of power not otherwise available for railway purposes. In countries where water-power is relatively abundant and fuel expensive, electric traction enables the natural energy of the waterfalls to be used for railway purposes, a point of enormous importance in view of the almost prohibitive rise in the cost of fuel in some countries since the war. This has been the predominating factor in Sweden, Bavaria, and Italy, and in certain parts of America. In other countries different features have formed the deciding reason for adopting electric traction. For example, the main lines outside New York, where heavy railway electrification began in the United States, were electrified after a tunnel accident attributed to an accumulation of noxious gases. Likewise, to avoid smoke in tunnels, the railways through the Baltimore tunnel in America and in the Simplon tunnel on the Continent were electrified. This was also a factor in the adoption of electric traction on the London underground railways. On the Chicago, Milwaukee, and St. Paul line, the power to negotiate steep gradients was the consideration which outweighed all others.

Disadvantages

Against the economy in power production must be placed not only the great capital cost of the plant, particularly great when the power is generated by water from an extensive area, the cost of the transmission of the power where the distances are considerable, interest on capital cost of the line, and its maintenance. Both the capital cost of plant and equipment and that of labour required for maintenance and operation have risen considerably since the war. On the other hand, both the vastly increased cost of fuel and the rise in the cost of labour handicap the steam railway more seriously than the electric, owing to the smaller operating and maintenance staffs required. In many cases, therefore, the comparison from the point of view of running expenses is more in favour of electricity than it was before the war.

Fig. 2.—A large electric passenger locomotive used on the Chicago, Milwaukee, and St. Paul Railway.
An example of the high-tension current system.

Economic Considerations

The point that must be investigated in each individual scheme is whether the advantages to be expected

from economy in power supply, increased capacity of the line for traffic, and so forth, are not outweighed by the capital cost of the conversion. An investigation indicates that at a certain traffic density electrical working will show sufficient advantage to justify the capital expenditure, and the higher the traffic density above this critical value the greater will be the advantage. The effect is to some extent cumulative in that the improvement of the service resulting from the change usually creates new traffic, so that the actual results may be even more favourable than were anticipated. Because of this it may be predicted that, given the requisite financial conditions for the raising of the capital, the future will see great developments in the electrification of railways which will be amply justified by their results.

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Rainfall and Civilisation

By Colonel H. de H. Haig, late R.E.

It is about one hundred years since Malthus startled and shocked the world with his theory, that the natural increase of the population must overtake the land surface of the earth on which it lives, because one is growing and the other is fixed and limited. The population is still growing, but it has not yet overstepped the numbers which can be supported. There are still large empty spaces, though unfortunately most of them are almost, if not quite, deserts.

Geographical Position of Deserts

If we take an atlas, the first thing that strikes us is that the deserts are not where they might be expected to be, that is, in the hottest part of the earth, on the Equator. The Sahara, for instance, is far to the north of the Equator. There, on the contrary, we find hot and steamy climates like Stanley's Rain Forest of the Congo, the Amazon Region, and the East Indian archipelago. The true deserts lie to the north and south of the Equatorial lands, forming roughly two rings round the earth, north and south of the tropics of Cancer and Capricorn. This points to some general and world-wide cause, which may be the circulation of the atmosphere at the Equator under the sun and the descent of the currents which form the trade winds.

The sun heats the air in the belt between the tropics and in consequence it expands and rises. When it reaches the higher atmosphere it rises above the surrounding air and has to overflow to the north or south. This rise and consequent expansion chills it, and the moisture condenses and falls as the well-known tropical rains.

The air thus chilled, dried, and pushed forward, flows over the warmer air beneath, gradually sinking on account of its greater density, until it reaches the surface of the earth in the regions just outside the tropics.

When it meets the surface the air is very dry, so that it greedily absorbs what moisture it encounters. If the surface be the sea it becomes a wet wind like the rainy south-west winds of Europe, but if it first impinges on the land, it dries up the surfaces and causes the deserts which extend roughly in two rings round the earth, and which seem to be continually tending to extend their boundaries.

Beginning with the Sahara, we have Arabia, Syria, Mesopotamia, Persia, Baluchistan, the Indian desert of Bikanir, and the Gobi. The belt continues in the same latitudes in North America in South California, Arizona, and New Mexico. Similarly in the Southern Hemisphere we have the Australian desert, North Chile, part of Peru, the Atacama Desert, and the Kalahari in South Africa.

Deserts as Centres of Past Empires

It is a significant fact that it is in these regions, obviously the very best parts of the earth's surface in ancient days, that the great nations of antiquity appeared—Assyria, Babylonia, Persia, Phœnicia, the Hittites, Crete, Egypt, Carthage, India, and China, and in the new world the Aztecs and Incas. All of these flourished in lands now suffering from insufficient rainfall, but which with abundant water easily yield two crops a year.

Effects of Climatic Change on Civilisations

There seem to be three stages through which countries pass:

(1) The rich and productive one, when the rainfall is abundant at all seasons, crops are certain, grazing is ample throughout the year, and in warm climates several crops can be raised.

(2) The irrigation stage, when the rainfall is insufficient or badly distributed. This necessitates the

laborious lifting of water from rivers or wells, the levelling of fields, the terracing of hillsides, lengthy canals and multitudinous distribution channels.

(3) The desert stage, when rains, rivers, and wells gradually diminish, crops are increasingly uncertain, and the country becomes derelict.

Practically the whole of the lands covered by the ancient empires come now under the last two headings. They are deserts or require irrigation, but when they were first settled they were no doubt in the primary stage of ample rainfall, for with the whole world open to him, man naturally would first choose the best places.

The centres of our modern civilisations are situated in countries in the first stage. They have sufficient rain, and irrigation is only resorted to locally and on a small scale. Is it not probable that no country which does not also come under that category can stand in the forefront of civilisation ? Unless it is sure of ample rains and certain crops, such as those obtainable in North Africa, parts of Arabia, Syria, Asia Minor, Mesopotamia, and Persia ?

There are many lands where the soil has gone out of cultivation. We blame the inhabitants for neglect, as in the old Turkish Empire. But are we right ? Is it not possibly the want of sufficient rainfall which interferes with cultivation ? The Turks are often accused of causing the decay of Mesopotamia and Asia Minor, which were so fertile that their rulers became the richest of men, like Crœsus, or the most gorgeous, like Sardanapalus and Mahomet the Magnificent. For centuries after the Turk had made himself master of these then most desirable territories, he lived in wealthy splendour as Caliph at Baghdad.

What is the reason for the decay of the Mohammedan power ? Is it not at least possible that the region from which it drew its wealth, food, and human material gradually dried and slipped out of the first stage into the second ? His energies were not equal to fighting drought and famine as well as human enemies, his base failed, his wealth disappeared in a few hundred years, and he fell from his high estate to make way for those in the north whose base was more secure.

Roman Cities in the Sahara

The evidence that our deserts were not always the barren wildernesses which they now are is overwhelming, especially so in the case of the Sahara, which has been much explored by the French since they assumed a protectorate over it. A few years ago a traveller called Fisher, an official of the Niger Protectorate, crossed it from Tripoli to Lake Tchad, a distance of 1,100 miles, along an old abandoned caravan route. He very nearly died of thirst, but won through with the greatest difficulty. He states in his book that at every halting-place he found stone buildings, wells, walls, and paved roads, some of which were undoubtedly of Roman origin. He climbed over mountains 4,000 and 5,000 feet high, snow-covered in the winter, and his camels ploughed through miles and miles of sand-dunes that "were only the dried alluvium of vanished rivers, accumulated in places by the prevailing winds." The country passed over was sand here and there, but most of it consisted of a network of water-worn valleys, some of immense size and length, in the hollows of which were the scarce oases and wells which enabled him to live.

In Roman days North Africa was a vast granary, divided into provinces such as Cyrene, Carthage, Numidia, Mauritania, etc., all of which possessed numerous large wealthy cities. Gibbon says that there were three hundred such cities in the district of Carthage alone. To-day all have disappeared, but scores of ruins of towns and vast aqueducts with forests of broken arches dot the plain, and rear their lofty walls as though they were the huge graves of a vanished civilisation. At one site all has been covered by sand except an enormous amphitheatre, towering alone in the hot shimmering desert air, which once vibrated with the groans of gladiators and the applause of the crowded arena. Now it is only the haunt of the lizard and the scorpion.[1]

There is an old Arab saying that "once you were able to walk from Mecca to Morocco in the shade." Those trees are now represented by fossils, which are still to be seen in Egypt standing or lying in their natural positions, but turned into stone.

Decline of Rainfall in Southern Europe

The danger zone has already spread to the countries near the Sahara. Spain, it cannot be denied, has suffered from the vicinity of her dangerous neighbour She was one of the richest provinces of Carthage and later of the Roman Empire. She was most prosperous in the Middle Ages under the Moors, and in the palmy days of Ferdinand and Isabella. Now she has reached the second stage. Most of her forests have disappeared—the effect, or it may be the cause, of the drought which necessitates irrigation of her parched slopes to produce good returns. A trifling fact will illustrate the change. The Mediterranean coast of Spain is believed to have been the original home of the rabbit, which was brought to England by the Romans. We know how it flourishes in Britain to-day, but its ancient habitat no longer produces enough

[1] See Gibbon's *Decline and Fall of the Roman Empire*, chapter li.

succulent herbage, and in consequence it has almost entirely disappeared there in a wild state.

France has not suffered so much, being farther away, but there are not wanting indications that the climate there has also dried considerably since men have occupied the land.

Italy also, being farther away, has not suffered so much as Spain, but she has begun to irrigate, and only lately opened the longest aqueduct in the world, in Apulia. Also it is evidently the failure of moisture in the Appenines that prevents the enormous production of wool which made Florence for centuries the centre of the cloth trade and the banking house of the world.

Sicily has sadly deteriorated. Once the garden of Europe, the coveted prize possessed by twelve nations in succession, and the granary of Rome, she now grows lemons and oranges by means of irrigation, and maintains a limited existence. She is no longer a prize to be conquered by the dominant race in the Mediterranean. Her uplands are deforested, either the cause or the result of drought, now so acute that sometimes for a whole year scarcely a drop of rain will fall. When Verres was the Governor under the Roman Empire, he made a corner in grain (the first on record) in the Roman market, by checking the sailings of the grain ships from Sicily.

Past and Future of Mesopotamia and Persia

Mesopotamia was once the most fertile region on earth. Its possession gave the wealth that made the great kings Sargon, Xerxes, Nebuchadnezzar, Darius, Cyrus, and many others down to the Caliph Haroun al Raschid of Baghdad. Its first set back was when Hulagu (a descendant of the terrible Genghis Khan, whose empire was the largest ever known on earth) deliberately put the population of Baghdad to the sword, at the same time that he cut the canals and irrigation system, compelling the people to resume their old nomadic life. Settlers on the land, in his opinion, were very inferior to herdsmen and wanderers. Now the water of the two rivers—Euphrates and Tigris—has fallen so low that there is not enough for both navigation and irrigation. Enormous sums would have to be spent to restore the fertility even if it were possible. The sources of the rivers of Mesopotamia have been deforested, and as they lie in Turkish territories, the present owners could not be expected to co-operate and spend their money and energy for the benefit of another people and another government.

Persia is the next desert country to which we come. One of the oldest empires in the world, it achieved wealth and civilisation many thousands of years ago. It was a conquering power at the dawn of Greek history and a menace to its neighbours. For four centuries it fought the Roman Empire for the rich prize of Mesopotamia, inflicting countless defeats on them, and once capturing a whole Roman army and the Emperor Valerian himself. Why has it decayed? Why has it now such a sparse population where once there were cities such as Persepolis and Susa, nearly as big as London? The curse of drought has fallen on it and it only exists by irrigation.

The Gobi Desert

In the centre of Asia is a group of deserts known generally as the "Gobi," though locally there are many other names. Sven Heydn and Sir Aurel Stein have done much exploration in them. Both report the existence of extensive ruins, temples, shrines, inscriptions, documents, mummies, and dried-up rivers and lakes. The difficulties of travel were so great owing to the absence of water that Sir Aurel Stein was only able to proceed in the winter, in the Lob Nor desert, because he could then load his camels with lumps of ice and by this means could spend a month at a time away from the water supply. He found there a dried up inland river system, leading to a lake bed without an outlet, and now quite deserted. It was the cradle of the Chinese race, from which they were forced by drought.

The true Gobi is supposed to have been the home of the Huns, against whose raids the Chinese, 2,000 years ago, built their famous wall, the largest work of man, which to this day faces the desert for 1,000 miles. In the north of this desert was the city of Karakorum, the capital of the empire of Genghis Khan, whence his armies commanded the whole of Asia, conquered the Crimea, defeated the Poles, and laid the Russian Grand Dukes under tribute. Marco Polo, the Venetian traveller, visited Karakorum in A.D. 1260, but he does not seem to have had any difficulty in crossing the Gobi, which therefore could not have been a desert at that time that is, if we can trust his veracity.

It would be tedious to go through the whole of the earth's deserts; enough has been brought forward to show the sameness of their history. They have not always been deserts, but have generally at some time supported humanity, in many instances very large and civilised populations. It seems as if there must be some cause, affecting the whole earth, reducing the available quantity of water, and gradually turning the fertile portions into uninhabitable regions. If so, what is the cause? Can it be met and neutralised in any way?

Reduction of the Earth's Water

It is plain that in the making of the earth it received as its share a definite quantity of water, which can

never be added to.[1] But can this quantity be reduced? That is the point, and the answer is that both its total amount and, worse still, its available quantity can be very seriously reduced in several ways.

(1) A glacial period, for instance, would lock up an immense quantity on the tops of the mountains, and reduce the amount available for rains.

(2) By chemical action a great deal of water is withdrawn into vegetation and into the rocks forming the substance of the earth.

(3) It may be broken up into its constituent gases and lost to the earth as water.

(4) Water may sink into the earth farther than it now goes and be out of reach of man and of the sun, which now raises it up into clouds and distributes it as rain.

The most dangerous cause of reduction is the last. It is admitted that the earth was once very hot, spinning in space and surrounded with masses of various vapours as Jupiter now is. As it chilled a crust formed, on which water condensed when it was cool enough. The seas collected in the hollows and, being very hot, evaporated rapidly, causing torrential rainfall which carved the surface into mountain, valley, and plain. None of the water could penetrate the surface, because it was so hot that it was driven out as steam. Thus the whole of the moisture was on the actual surface or in the clouds.

As the earth cooled, water was able to penetrate the surface more and more, following the heated core as closely as the temperature would allow. The whole crust is permeable, though not equally so. All rocks and strata hold water to greater or less degree. It is not possible to sink a deep shaft for a mine without encountering water, as we know to our cost, for it has to be pumped out at great expense. It is common knowledge that, if a mine is not worked, it is soon flooded.

We are thus irresistibly forced to the conclusion that we are in the midst of a gradual progressive drying up of our earth, due to causes almost entirely out of our control, which has already destroyed a great deal of the best parts of the earth's surface and now menaces the rest, and which must sooner or later put an end to our race and all other life on the world.

What of the Future?

Though the world is drying up, mankind can probably delay the process, if the nations will work together to this end. Our nearest planetary neighbour, Mars, is apparently in worse case than we are, having reached a more decrepit stage of stellar existence. There, according to Professors Schiapparelli, Lowell and Pickering, life exists, but it is only made possible by irrigation on a world-wide scale. Whether, when the earth reaches this stage, there will be a struggle for the water sources or not, is a problem that the future only can solve.

[1] N.B.—The products of combustion appear to add water, but really the actions of breathing and fire only cause the return of what has been abstracted by the processes of life.

Reviews of Books

SCIENCE AND PROGRESS

Science and Human Affairs from the Viewpoint of Biology. By Winterton C. Curtis, Ph.D., Professor of Zoology in the University of Missouri. (G. Bell & Sons, 15*s*.)

Progress and Science. Essays in Criticism. By Robert Shafer. (Yale University Press, 12*s*.)

We live in a world to-day which is ruled by the great god Science. Our very thoughts are dissected under its laws; we are born with all the resources of science to expedite us, and die with all the resources of science to delay us; in the years between we are fed with food rushed from the ends of the earth by the scientific control of energy. We are in the very whirlpool of the scientific age—from the day we first listen with amazement to the ticking of an uncle's gold watch to the day when we observe with anxious hope the last doctor's latest instrument. We are face to face with an ever-widening vista of fact and experiment and scientific theory which is bewildering in its variety and utterly beyond our powers to grasp in its entirety.

And at times we ask ourselves certain questions. What is progress, and how does science advance it? What are the great fundamental ideas underlying the scientist's outlook to-day? And, above all, how did all this marvel of science begin, how did men live and think in the far-away years, and what do we inherit from the remote past?

Professor Curtis's book provides us with answers to all these questions. They are the answers of a man to whom science is the all-sufficient motive in life. He does not consider very deeply whither humanity is bound; it suffices for him to know that we are slowly learning what truth is. So the fairies and ghosts—and even, it seems, Michael and all the angels—leave the dark nights which once they haunted or made glad, and the stars and the moon come into their own to provide an alternative magic and poetry. He tells us how it all began—in Greece, where man's unfettered mind first sought for great unifying truths; in Egypt, where mechanical invention came to birth; in Mesopotamia, where men learned to deal with numbers and laid the foundations of mathematics. There came the fall of ancient civilisation and the Dark Ages as a flood to submerge all that had been won of fact and theory and method over three thousand years. Professor Curtis sees in the Middle Ages the crushing power of authority in the form of the Church effectually sub-

duing and controlling the divine curiosity of men. And then, as Professor Curtis views the history of civilisation, there comes the welcome dawn, and the new theories of life—the theory of evolution, the theory of the cell-structure of living creatures—to change the mind of man, and, furthermore, a hundred inventions which altered the face of the earth.

This is a really good book. It fulfils the first essential of a good book—it is interesting. It is well balanced, and gives us a glimpse of a very wide variety of subjects. It preaches the doctrine of "Science for its own sake." All knowledge is useful knowledge. The Dutch microscopist, Leeuwenhoek, who first described little animals in water in which pepper had lain infused, pointed the way to Pasteur and Lister and the germ theory of disease. The author considers that the industrial spirit of to-day is the great enemy of science; commerce was born of science, and now ungratefully forces research into lines of obviously and immediately useful discovery, rather than into general and impartial efforts to know "how the wheels go round."

It is an interesting and instructive study in the varieties of the human mind to turn to another American book, Mr. R. Shafer's *Progress and Science*. We turned the last page of Professor Curtis's book with a slight feeling of dissatisfaction. We were asked to be so completely contented wtih science. It seemed a rather comfortless prospect. There was so much else besides facts to be reckoned with in the tangle of human life. "Instincts immature," "Purposes unsure," "Fancies that broke through language and escaped," did not seem to fit into his picture. We whispered with Bernard Shaw, "Life's not logical. So much the worse for logic."

And here is a book which has serious doubts about science. Like our English Dean Inge, the author does not believe that our ant-like activities really advance humanity. He is far more dismal than our own optimistic pessimist; his final opinion is that, "We are bound to conclude that there is at present no valid ground for belief that life will ever be easy or pleasant for the vast majority of mankind." We turned from Professor Curtis, regretting our "banshees," and find Mr. Shafer too unhappy even to find relief in them. "Industry has succeeded only through oppression." "The term 'labour-saving device' is little else than a fool's coinage." Evolution gives no guarantee that an ethically or æsthetically good quality will be evolved. However, although we can gather that he appreciates certain spiritual values of the very religious instinct that to Professor Curtis was anathema, he does not tell us what real progress would be. He quotes Descartes: "We shall be able to find an art, by which, knowing the force and action of fire, water, air, stars, the heavens, and all other objects, as clearly as we know the various trades of our artisans, we may be able to employ them in the same way for their appropriate uses, and make ourselves the masters and possessors of nature. And this will be not solely for the pleasure of enjoying with ease and by ingenious devices all the good things of the world, but principally for the preservation and improvement of human health, which is both the foundation of all other goods and the means of strengthening and quickening the spirit itself." But he cannot find solace even in such a prospect.

For ourselves, we meekly subscribe to Descartes' fine prophecy. We think of Matthew Arnold's "Hymn of Empedocles":

"I say, Fear not! Life still
Leaves human effort scope,
But since life teems with ill,
Nurse no extravagant hope
Because thou must not dream, thou need'st not then despair."

There is no panacea for human happiness. Truth lives at the bottom of a well—there are many wells, and men will till the end of time go seeking her as fancy takes them. Cannot we keep our fairies, even if science teaches us how best to trap them? What harm can there be if science hastens our journey from well to well, helps us to cram a few more journeys into the short space of our days? And, even if the one gift of science were relief from pain, would it not by that gift be consummately justified?

R. J. V. Pulvertaft.

A SIDELIGHT ON THE NEAR EAST PROBLEM

Greece and the Allies, 1914–1922. By G. F. Abbott. (Methuen & Co., Ltd., 7s. 6d.)

The claim that history may be considered an exact science is now generally accepted; but the head master who stated that "any good classical scholar could 'get up' history in a fortnight" still expresses the attitude of a minority. This minority feels that the difficulty of obtaining reliable data confines the scope of the historian to the recording of a more or less inaccurate narrative of purely academic interest. Indeed, the study of contemporary history, in which prejudice and inaccuracy can only be dealt with by a process of cancellation, throws a convincing light on the difficulties of the political scientist or economist who would build theories of early civilisation from a few broken records.

Mr. Abbott's book will be of great value to the discriminating student of contemporary history, since it shows the situation in the Near East not only in an entirely new light, but supplies a wealth of hitherto unpublished information. There is a popular feeling that if it is worth while for someone to suppress information, that information is worth getting, and Mr. Abbott's book loses nothing in attractiveness from the statement in his preface that, owing to the activities of D.O.R.A., "not until now has it been possible for the voice of facts to refute the fables dictated by interest and accepted by credulity." Nevertheless, Mr. Abbott has done more than give us a mere record of facts; he has penned an indictment first of M. Venizelos, and secondly of the diplomacy of the Entente. The indictment is able and the defence for the Allies would be hard put to it to make out a case. It is a startling record of indecision and blundering. "By shilly-shallying at Athens, Nish, and

Sofia they only lost the confidence of the Greek and Serbs without gaining that of the Bulgars."

The account of the policy of bullying interference with the Greeks is a sharp blow to our national pride. Perhaps this is why we turn with such relief to Mr. Abbott's explanation that it was all France's fault. "France pursues now the plan laid down by Louis XIV, continued by Napoleon, fitfully carried on in the nineteenth century and facilitated by her installation in Syria—the equivalent of the German *Drang nach Osten*: a plan incompatible with the safety of the British Empire in the East." The policy of creating a Greece dependent on France and capable of being used to further French policy in the East has, he holds, been consistent. The reversal of that policy is a sudden change due to finding Greek feeling entirely anti-French. At all events this book throws considerable light on the apparently anti-French policy which the late Government pursued in the Near East. From Mr. Abbott's account it would seem that the French sowed the pro-Greek policy and left us to reap the Turkish whirlwind.

The writer's chief charge against M. Venizelos is one of deliberate misrepresentation of King Constantine's motives and personality. To those accustomed to look upon the king as the serio-comic villain of the piece it is surprising to learn that "in town, mansion, and village huts men's mouths were filled with his praise," that a weeping crowd obstructed the path of the car that bore him from Greece and that wild acclamation greeted his return. But there is a vaguely familiar ring about the indictment of "the Cretan" which is puzzling, since our Press has been as unanimous in praising M. Venizelos as in condemning ex-King Constantine. M. Venizelos is described by our author as a "man of many talents and few principles, ready to employ the most tortuous and unscrupulous methods—sometimes indeed for ends in themselves patriotic but often merely for aggrandising himself."

We have heard something like that before, but it was about one of our own politicians. It is the same controversy about brains and character which is perplexing many of us in England. There is a tendency, doubtless healthy, to grudge "principle" to all but the mentally mediocre; a feeling that not only may a lady be "too pretty to be good," but that a politician may be too clever to be principled. Mr. Abbott tells us of M. Venizelos at the beginning of his career that "the new man did not disappoint the faith placed in him. Through the next two years he stood in every eye as the embodiment of constructive statesmanship. . . . Greece seemed as an invalid, healed and ready to face the future." It is hard to believe that this man is an unscrupulous opportunist. Is it not at least a possibility that M. Venizelos is a genuine and single-minded patriot, and that the troubles of his country are due rather to Allied intrigue than to his own bad judgment or unscrupulous methods? At all events we prefer to reserve judgment until we hear the other side.

Mr. Abbott's book is obviously written with the purpose of vindicating the good name of Greece. We are too near the period which he covers, and we are certainly too near the results of that period, which have involved us in such a perplexing position in the Near East, to pronounce a definite opinion upon the attitude which he has assumed. But this we can say about the book, that it will provide a valuable antidote to the one-sided propaganda of our daily Press since 1915.

E. L. M. C.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Bibliography of English Language and Literature, 1921. Edited for the Modern Humanities Research Association by A. C. Panes. (Bowes & Bowes, Cambridge, 4*s*. 6*d*.)

The Pattern of the "Iliad." By J. T. Sheppard, M.A., Litt.D. (Methuen & Co., Ltd., 7*s*. 6*d*.)

Early British Trackways. By Alfred Watkins. (Hereford: The Watkins Motor Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., 4*s*. 6*d*.)

Lola, or the Thought and Speech of Animals. By Henry Kindermann. (Methuen & Co., Ltd., 6*s*.)

Greece and the Allies, 1914–1922. By G. F. Abbott. With a Preface by Admiral Mark Kerr, C.B., M.V.O. (Methuen & Co., Ltd., 7*s*. 6*d*.)

Everyday Life in the New Stone, Bronze, and Early Iron Ages. Written and Illustrated by Marjorie and C. H. B. Quennell. (B. T. Batsford, Ltd., 5*s*.)

Water-Power in the British Empire. The Reports of the Water-Power Committee of the Conjoint Board of Scientific Societies. By Sir Dugald Clerk, K.B.E., F.R.S., and Prof. A. H. Gibson, D.Sc., M.Inst.C.E. (Constable & Co., Ltd., 5*s*.)

Readings from the Literature of Ancient Rome. In English Translations. By Dora Pym. (George G. Harrap & Co., Ltd., 3*s*. 6*d*.)

PSYCHOLOGY AND PHILOSOPHY

The Measurement of Emotion. By W. Whately Smith, M.A. With Introduction by William Brown, M.D., D.Sc. (The International Library of Psychology, Philosophy, and Scientific Method: Kegan Paul, Trench, Trübner & Co., Ltd., 10*s*. 6*d*.)

Tractatus Logico-Philosophicus. By L. Wittgenstein. With Introduction by Bertrand Russell, F.R.S. (The International Library of Psychology, Philosophy, and Scientific Method: Kegan Paul, Trench, Trübner & Co., Ltd., 10*s*. 6*d*.)

Our Unconscious Mind and How to Use It. By Frederick Pierce. (Kegan Paul, Trench, Trübner & Co., Ltd., 10*s*. 6*d*.)

SCIENCE

Pages of Science. Selected and edited by GEORGE SAMPSON. (Methuen & Co., Ltd., 2*s.*)

The Microscope. A practical handbook. By LEWIS WRIGHT. Enlarged and revised by A. H. DREW, D.Sc., F.R.M.S. (Religious Tract Society, 5*s.*)

English Coastal Evolution. By E. M. WARD, M.A. (Methuen & Co., Ltd., 8*s.* 6*d.*)

An informed and interesting account in moderate compass of a somewhat neglected subject. After discussing the problem generally the author describes different parts of the coast in some detail.

Chemistry in the Service of the Community. By ARNOLD ROWSBY TANKARD, F.I.C. (Benn Brothers, 1*s.*)

An article in praise of chemistry by the public analyst and bacteriologist of Hull, dealing shortly with fertilisers, foodstuffs, adulteration of food, chemistry in industry, etc.

History of Chemistry. By FRANCIS P. VENABLE, Ph.D., D.Sc., LL.D. (George G. Harrap & Co., 5*s.*)

An American book, readable and accurate, but containing the barest outline of the subject (for example, one paragraph only on colloids), and consequently suitable only for a first reading.

Crystal Receivers for Broadcast Reception. By P. W. HARRIS. (1*s.* 6*d.*)

The Wireless Telephone : What it is and How it Works. By P. R. COURSEY, B.Sc. (2*s.* 6*d.*)

Masts and Aerial Construction for Amateurs. By F. J. AINSLEY, A.M.I.C.E. (1*s.* 6*d.*)

The Perry Auto-Time Morse System. By F. W. PERRY. (6*d.*)

(All published by the Wireless Press, Ltd.)

Books for "wireless amateurs," simply and carefully written and well illustrated.

Direction and Position Finding by Wireless. By R. KEEN, B.Eng., A.M.I.E.E. (The Wireless Press, Ltd., 9*s.*)

A monograph for the serious student, dealing not only with the principles of the subject, but also with such practical matters as constructional details, the use of maps, freak phenomena, the mastering of difficulties, and the elimination of faults. It should be of real use to an engineer studying this department of wireless work for the first time.

Wireless Popular and Concise. By LT.-COL. C. G. CHETWODE CRAWLEY, R.M.A., M.I.E.E. (Hutchinson & Co., 1*s.* 6*d.*)

The elements of the subjects put clearly by an authority. Portions of the book have already appeared in DISCOVERY as articles. A good introduction to the subject.

The Meaning of Relativity. By ALBERT EINSTEIN. Translated by PROF. E. P. ADAMS, Princeton University. (Methuen & Co., Ltd., 5*s.*)

Four lectures delivered at Princeton University in May 1921, on Space and Time in Pre-Relativity Physics, the Theory of Special Relativity, and the General Theory of Relativity. For advanced physicists and mathematicians.

Correspondence

ENGLISH PLACE-NAMES

To the Editor of DISCOVERY

SIR,

I am so strongly in sympathy with the view that the co-operation of topographers is essential if place-name studies are to be put upon a sure basis that to prevent misunderstanding I had better, perhaps, define my own attitude toward the matter, which is also that of those who are responsible for the Survey of English Place-names. It is that no explanation of a place-name based upon a study of its old forms should be offered if it is inconsistent with the known topographical facts. If, however, the co-operation is to be a full and just one, it is equally important to recognise the converse of that proposition, viz. that no explanation of a name based upon topographical considerations alone can be accepted if it is inconsistent with the early forms of the name. I ventured to criticise Mr. Watkins's views only so far as they seemed not to fulfil this second condition of place-name interpretation.

Yours, etc.,
ALLEN MAWER.

DIRECTOR,
SURVEY OF ENGLISH PLACE-NAMES,
THE UNIVERSITY, LIVERPOOL.
November 6, 1922.

[This letter from Professor Mawer is a reply to a letter by Mr. Alfred Watkins which appeared in the last number of DISCOVERY.—ED.]

Continued from page 8.]

that the discovery amongst other objects consists of "the funeral paraphernalia of the Egyptian King Tutankhamen, one of the famous heretic Kings of the 18th dynasty, who reverted to Amen worship. Little is known of the later Kings, including Tutankhamen, and the discovery should add invaluably to our knowledge of this period and of the great city of Tel el Amarna, which was founded in the fifteenth century B.C., by Amenhotep IV, the first of the heretic Kings."

No such quantity of furniture and provisions of the most valuable kind, dating back to about 3,500 years, has ever before been found intact. We hope to publish an account of the excavations in an early subsequent number. Meanwhile, we can only say that it is a strange coincidence that it occurred in 1922, a year which may be justly regarded as the Centenary of Egyptology, for in 1822 a young Frenchman, Champollion, discovered a definite clue to the interpretation of Ancient Egyptian Hieroglyphics on the famous Rosetta stone, as the result of which the study of Egyptology grew apace.

CONFERENCE IN CLASSICAL ARCHÆOLOGY

A CONFERENCE in Classical Archæology will be held at Oxford, with the sanction of the Committee for Classical Archæology, in the Ashmolean Museum (by permission of the Visitors) from January 9 to 16, 1923. Lectures, discussions, and demonstrations will be held concerning Greek and Roman monuments and antiquities. The fee for membership will be £1. Applications for membership are received by the Hon. Secretary, Mr. Stanley Casson, New College, Oxford. The Conference is intended, in the first instance, for those engaged in teaching. A programme of the conference and general information as to accommodation will be issued later.

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Editorial Notes

NOTHING in the way of archæological discoveries has so stirred the world as Lord Carnarvon's and Mr. Howard Carter's successful excavations, resulting in the finding of Tutankhamon's funerary relics, in Upper Egypt. In this issue we publish an article by Professor T. E. Peet on the life of this monarch and a description by Dr. A. M. Blackman of the plundering of the Tombs of the Kings in the XXth and XXIst Dynasties, which accounts for the rarity of such a "find." To him who is interested in the history of mankind the chief value of the discovery will doubtless lie in the new light which the papyri will throw upon this stage of the world's civilisation, and, even more especially, in the beauty of the furniture and other articles in the tomb.

* * * * *

Almost every day brings news of some remarkable invention which will increase the comfort of, and the means of communication between, the inhabitants of our earth. The fact is that, ever since the introduction of steam power in the beginning of the last century, mankind has improved its methods of living and accelerated his knowledge of the universe to a greater extent than in the whole ten or twelve thousand years of civilisation preceding this event. During the last few years we have so developed the wireless system that we can reproduce a concert in New York in a flat in London, and transmit photographs and the human voice over thousands of miles of space; we have been able to produce machines which will fly through the air at the rate of 200 miles an hour or which will carry upwards of twenty to thirty passengers; we have cut the American continent in two with a canal connecting up one hemisphere with another; we have built enormous liners which can carry us across the Atlantic in four days under conditions not merely of comfort, but of luxury; we have, in fact, reduced most places of habitation on this globe to an accessibility from any other place of habitation which was little more than dreamed of twenty years ago.

* * * * *

These are merely a few examples of recent improvements in intercommunication, and we could quote other improvements such as the supply of fruit to Europe from the tropics. Bananas, for instance, can nowadays be bought at a shop in England little over a fortnight after they have been plucked from a tree on a Central American plantation. They are brought to this country in fast and specially constructed ships, in which the main body containing the holds forms merely the kernel, so to speak. In the space between this and the outer walls electric fans blow air over refrigerating pipes, thus keeping the fruit down to the required temperature. Much of the fish to be found in our modern markets has reached this country from as far away as the coasts of Iceland and Morocco, having been carefully maintained in condition by means of elaborate refrigerating apparatus. As to railways, telephones, electric lighting, and motor-cars, we take these as a matter of course in our daily life.

* * * * *

But for all these so-called improvements in our lot we have had to pay a price. The South Sea Islanders (or, rather, those of them who have not been brought under our influence) can wait for food to fall off the trees, do not have to be continually dressing and undressing, and, so far as we can gather, appear to lead lives of almost complete contentment and idleness. On the other hand, the average citizen of our country has to work for eight hours a day nearly all the year round in order that he may be provided with the comforts and entertainments which he so much prizes. From morning to evening he lives in a

continuous state of activity which often robs him of sleep at night. Beyond his work, he has little time for anything except hurried pleasure.

* * * * *

As the years pass by, we shall doubtless adapt ourselves to these new conditions of life, changing gradually our economic standards and our means of production. Meanwhile, are we in danger of losing that high sense of beauty which has characterised the evolution of man for several thousand years, and which is so clearly manifested as existing over three thousand years ago by these new testimonies to the civilisation of the ancient Egyptians? Is it possible that great art can be created and enjoyed to-day? Great Britain and the United States of America and Germany are typical industrial nations. Comparisons are apt to give false verdicts, but the inhabitants of Italy and Austria appear on the average to possess a greater sense of beauty than the inhabitants of these three nations. We should not like absolutely to lay down the law on this point. We are too near to our own age ever to judge of it fairly and, at least, the love of beauty still lives on to a greater or less degree in the hearts of most of us. Future changes may yet restore to us an existence of greater peace and contemplation, and in the present we may well seek a refuge from turbulent realities in searching for the loveliness which exists even in our feverish world:

A thing of beauty is a joy for ever:
Its loveliness increases; it will never
Pass into nothingness; but still will keep
A bower quiet for us, and a sleep
Full of sweet dreams, and health, and quiet breathing.

AN AERONAUTICAL LIBRARY

The Council of the Royal Aeronautical Society announces that through the generosity of the Trustees of the Carnegie United Kingdom Trust it has been able to arrange for the purchase of a large number of valuable historical books on aeronautics which would otherwise have shortly been sold to an American purchaser. This purchase, together with the works already possessed by the Society, renders its collection of early and modern aeronautical literature probably unsurpassed in this or any other country. Comprising as it does many early works of extreme rarity as well as the most modern English and foreign treatises, the Society's library will now form a complete collection of all important works on aeronautics from the eighteenth century down to the present day. In recognition of its appreciation of their generosity the Council of the Royal Aeronautical Society has, at the request of the Carnegie Trustees, agreed to make the books in the Society's library available for any student in the British Isles through the medium of the Central Library for Students, 9 Galen Place, London, W.C.1. The Central Library for students has been formed by the Carnegie Trustees to provide a loan collection for students of technical books which are unsuitable for placing in rural libraries. By receiving permission to use the Royal Aeronautical Society's Library the Central Library for Students will be spared the necessity of forming a special section devoted to aeronautics.

The Life of King Tutankhamon

By T. E. Peet, M.A.

Professor of Egyptology in the University of Liverpool

It is an evil moment in which to attempt to write a life of King Tutankhamon, for if the papyri found among Lord Carnarvon's treasure in the new tomb really prove to be of historical import, they will revolutionise our knowledge of this ruler. At the same time it may enhance the value of the new discovery if we can succeed in realising how small our knowledge at present is.

Tutankhamon's Father-in-Law, Institutor of the Sun Cult

Readers of Discovery[1] will remember that about 1370 B.C. the young King Amenhotep IV abandoned the religion and the capital of his fathers, and moved from Thebes to a place now known as Tell el-Amarna 300 miles farther down the Nile, where, under the new name of Akhenaten, he devoted his life to the worship of the Sun God under the form of the Aten or Disk, after doing everything in his power to suppress the worship of all other deities throughout his kingdom. We know from the year-dates on wine jars found at Tell el-Amarna, or Akhetaten, as the Egyptians called it, that this king reigned at least seventeen years. He had no sons, but seven daughters; of these the eldest was married to a man named Sakere (sometimes read Smenkhkere), the second died in childhood, and the third, Ankhesenpaaten, was married to Tutankhamon, who in those days was called Tutankhaten. When Akhenaten died he was succeeded by Sakere, the length of whose reign we do not know, though there is every reason to suppose that it was very short. On his death the second son-in-law, Tutankhaten, ascended the throne. It is certain that he ruled for some time in Akhetaten, for large numbers of scarabs and blue glaze finger-rings inscribed with his name have been found there. Yet we have no means of ascertaining how long his rule in Akhetaten lasted, for not a single object of his with a year-date has as yet been found there.

Why Tutankhamon Returned to Thebes

It is, however, certain that sooner or later, probably sooner, he decided to abandon Akhetaten and return with the Court to Thebes. The reasons for this step are probably to be found in the unpopularity of the new Disk-worship. The change had hit very hard

[1] See *The City of the Sun Cult*, by Prof. T. E. Peet, in Discovery, vol. ii, No. 22.

FIG. 1. WHERE KING TUTANKHAMON SPENT THE EARLY DAYS OF HIS REIGN.
The ruins of the City of the Sun Cult at Tell el-Amarna.

FIG. 2.—WHERE HIS REMARKABLE TOMB HAS BEEN RECENTLY DISCOVERED IN THE VALLEY OF THE KINGS.
The gateway in the centre is that of the tomb of Rameses IX. Below it, marked with a cross, is the excavation leading to the chambers in which treasure worth more than £3,000,000 has already been found.

at the priesthood of Amon in Thebes, and doubtless its members had not accepted their defeat tamely. The throne had lost heavily in prestige by the abandonment of the Egyptian empire in Syria, and Tutankhaten may well have found that some sort of compromise with the old religion and the old politics was becoming a necessity if the throne was to continue to stand. Signs of this are evident even before the desertion of Akhetaten. In 1921 the Egypt Exploration Society found there tomb-chapels in which the customary prayers were inscribed, not to the Aten or Disk, but to Amon—an eloquent sign of the times.

At the same time, even after his return to Thebes, the king did not wholly give up the worship of the Disk, for in the pylon built by his almost immediate successor, Horemheb (1350—1315 B.C.), at Karnak were re-used stones taken from a temple built to the Aton by Amenhotep III, the father of Akhenaten, and continued, as the fragments of inscription show, by Tutankhaten. We do not even know at what moment he changed his name from Tutankhaten, "Living image of the Disk," to Tutankhamon, "Living Image of Amon," but we may nevertheless see in it a great concession to the old order of things. Eventually, however, he was compelled to go much farther in the way of concession, and to restore the name of Amon which Akhenaten had carefully chiselled out on most of the accessible monuments throughout Egypt. And he was finally forced to restore the old calendar of divine festivals and to celebrate himself the Opet feast of Amon, a fact which we learn from the reliefs in the temple of Luxor.

His Empire

The length of his reign in Thebes is again unknown to us, and we have not a single dated object of his. One monument, however, though undated, is of value, for it throws some light on foreign relations.

In the cliffs of Qurnet Murrai at Thebes, not far from Tutankhamon's newly found tomb in the Valley of the Kings, is cut the rock-tomb of a certain Huy who lived during this reign. He bears the title of "Prince of Kush," which was the name given at this period to the Egyptian viceroy of Upper Nubia. On the walls of the tomb is a scene where, in the presence of King Tutankhamon himself, Huy receives from an officer of the Treasury the seal borne by the Viceroy of Nubia. Another scene shows Huy presenting to the king the tribute of the country under his administration. We may safely argue from this that the province of Nubia, first conquered in the Old Kingdom, perhaps as early as 2500 B.C., and consolidated by the great monarchs of the XIIth Dynasty (2000—1800 B.C.), had not been lost to Egypt during the years of Akhenaten, when foreign politics had been so sadly neglected. Nay more, since Huy is accompanied in the scene by his brother Amenhotep, who is also called Viceroy of Nubia, we might even argue that Nubia had become important enough to need two viceroys.

In a further scene these two officials also present the "tribute of the North," i.e. of Syria. This is at first sight astonishing, for it is clear from the famous Tell el-Amarna letters that Akhenaten had completely lost the Egyptian empire in Syria. Why, moreover, should the Viceroys of Nubia present the tribute of Syria? We are driven to suspect that the tribute of the North is in this tomb something of a figment, put in after the fashion of the glorious old days of Thothmes III to balance that of the South. On the other hand, King Horemheb, who was originally a general under Akhenaten, calls himself in his tomb-inscription "Companion of the feet of his master on the field of battle on that day of slaughtering the Asiatics": thus either Akhenaten himself (which is improbable) or one of his immediate successors must have conducted a campaign against Syria in which Horemheb took part, and the flow of tribute may have been restored on this occasion.

Such is the history of Tutankhamon so far as it is known to us, if we may describe as history what is nothing more than a series of inferences from archæological remains. The Cairo Museum possesses one statue of the king, found at Karnak, and sometimes described wrongly as a portrait of Akhenaten, while at least two of the admirable portrait-heads found by the German expedition in the workshop of the sculptor Thothmes at Tell el-Amarna represent him and not, as at first supposed, his father-in-law.

Garibaldi's Bride of an Hour

By Thomas Okey, M.A.

Professor of Italian in the University of Cambridge

I

One May day in the year 1859 a number of Austrian officers were supping in the barracks at Varese when an unexpected visitor was announced. "Who are you?" asked the White Coats. "I am Garibaldi," was the answer, "and you are my prisoners." Believing the dread chieftain had his red-shirts behind him, they surrendered. As a matter of fact, Garibaldi was

alone; an hour later the *Cacciatori*[1] arrived and Varese was won for Victor Emmanuel.

The North Italian campaign did not always fare so miraculously, and on June 1, after the failure of the attempt to surprise the Austrian fort of Laveno by a night attack, Garibaldi, returning disappointed to his headquarters at Varese, flung himself wearily down on the grass at Robarello to snatch a brief rest—a saddle for his pillow, his covering a poncho, sabre and map by his side. After an hour's sleep he rose and, with an officer of his staff, rode along the way to S. Ambrogio. An open carriage met them; in it a priest and a young Italian girl of rare beauty, radiant in her bloom of sixteen years.

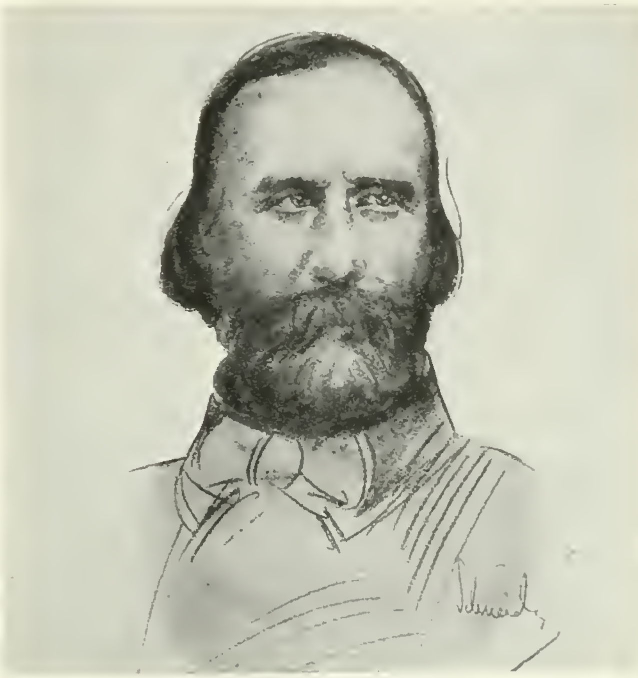
"What lovely scouts the enemy sends us!" exclaimed Garibaldi, as with a firm, resolute air the girl alighted, strode towards him, and began to speak. The general leaped from his horse and entered a wayside inn. There, having hastily scribbled a letter, he handed it to the beautiful messenger with the words: "Say they are to hold fast till to-morrow, when I will relieve them with my *Cacciatori*."

The fair dispatch-carrier was Donna Giuseppina, daughter of the Marchese Giacomo Raimondi, head of a patrician house of Como—a patriot who had been exiled to the canton Ticino in 1849 as a suspect to the Austrian police. Giuseppina's part, and a perilous one it was, had been to bear from her banished father's retreat proclamations and instructions across the frontier to the brethren in Italy. With ardent zeal for the cause she had now assumed the still more perilous mission of bearing secret and confidential information through the enemy lines to Garibaldi. Como was then menaced by Austrians without and pro-Austrians within, and Giuseppina brought priceless information of the enemy's movements, and appeals for help from the hard-pressed Italians. The patriotic priest was Don Luigi Giudici, who had risked his life by accompanying her.

Having written the letter, Garibaldi placed it in Giuseppina's left hand, for her right hand, wounded by a fall, was swathed in bandages. The letter was directed to Emilio Visconti Venosta, Cavour's representative, and gave details of the military situation in Varese, with an appeal to the men of Como to hold on, for he was hastening to their relief. "Send away those who are afraid, and the women and children, and let the male population, supported by our Camozzi,[2] the two companies of regulars, and the volunteers, sound the tocsin and look for me."

Garibaldi, always susceptible to the attraction of the eternal feminine, appears to have been smitten by the grace, beauty, and fortitude of the girl messenger of Como; but the vicissitudes of the campaign left him small opportunity for sentiment.

A little more than a month passes since the meeting at Robarello, and the scene changes to the Villa Raimondi at Fino Mornasco, near Como. Bitter disappointment had followed on the Varese campaign and on the Franco-Italian alliance of 1859 the betrayal of Villafranca. At the Villa Raimondi the politically betrayed hero—for such he stoutly believed himself to be—found sympathy and repose. The old marquis welcomed him with enthusiasm; walks, drives, rides in the lovely surroundings of the villa; picnics amid the entrancing beauty of woods, the hills, the lake of Como, accompanied by the Marchese, the Marchesa, and, not the least attraction, Donna Giuseppina and her two sweet sisters, were as balm to the wounded spirit of the disappointed Liberator. He was fascinated, says Guerzoni, by the bewitching mirage of the fair Amazon, and, forgetting his half-century of years, a renewal of the heroic idylls of the pampas, associated with the memory of Anita, floated before his fancy.



GARIBALDI AT ABOUT FIFTY YEARS OF AGE.
(*By courtesy of G. M. Trevelyan, Esq.*)

But—enter the dramatic muse on the idyllic scene. The general, proud of his horsemanship—and who

[1] In order to remove any ambiguity as to the military status of Garibaldi's volunteers Cavour incorporated them in the regular army as a corps of *Chasseurs* (*Cacciatori*) and appointed Garibaldi their general.

[2] Gabriele Camozzi, a patriot of Bergamo, at whose villa in December 1858 the poet Mercantini composed and sang the famous Garibaldian hymn: "Si scuopran le tombe: si levano i morti."

would not be before so fair an audience ?—insisted one morning on mounting a restive, almost unbroken horse from the Marquis' stables. Riding in furiously, his knee struck against a stone pillar at the entrance to the grounds. Now an injury to the knee (as those well know who, like the writer, have suffered from housemaid's knee) is an obstinate matter. There was no help for it. Even heroes must to bed and be exiled to the land of counterpane on such occasions. And who so gentle and tender a nurse as the fair Giuseppina ? Pity and admiration wrought their way, and there were intimate talks in that patrician sick-chamber —words that

> Spake of most disastrous chances :
> Of moving accidents by flood and field,
> Of hairbreadth 'scapes in the imminent deadly breach.

This to hear would Giuseppina seriously incline. But was it love or only the admiration of a high-spirited girl for a soldier ? The sequel will show.

II

Seductive visions now hovered before the heads of the Raimondi household. The old Marquis beheld himself father-in-law of Italy's darling hero ; the prestige of his house exalted by an alliance with the great chieftain. Political considerations also intervened. Garibaldi was a difficult ally, and his republican tendencies a source of grave concern to Cavour. Could not the fiery guerrilla leader be shorn of his republican intransigency if safely united by marriage to the daughter of a great and illustrious Lombard patrician house, more docile to high considerations of monarchical statecraft ? Cavour was delighted, and a marriage was decided on. True, there was a difference of thirty-two years between bridegroom and bride, but had not the Princess Clothilde, the fifteen-year-old child of Victor Emmanuel, been sacrificed to that blasé old roué, Prince Napoleon ? The *raison d'état* laughs at sentiment, and who among the daughters of Italy could hesitate, or resist the glory of becoming the wife of a Garibaldi, hero, not only of Italy, but of a thousand lands ? What child disobey an honoured father whose unhoped-for ambition could thus be realised ? On January 24, 1860, by special dispensation of the Bishop of Como, the marriage ceremony took place in the family church of the Villa Raimondi, and Giuseppina Raimondi became the wife of Giuseppe Garibaldi.

III

Again the scene changes. The ceremony ended, bride and bridegroom and the small bridal procession issue from the chapel. They are arrested by the arrival of a horseman riding in hot haste. It is a Garibaldian officer who hands a letter to the general. Garibaldi seizes the letter, opens, reads, stands a moment as if dazed. Then, turning to his newly wedded wife, said : " Allow me, I must speak with you a moment." Giuseppina, with a chill at her heart, but with full self-command, answered : " I will follow you." Near-by was a little rustic shelter, reminiscent of many an intimate talk as they had been wont to rest in its grateful shade. They enter. Garibaldi hands her the letter.

" Is it true ? " he demands. " Is what this letter says true ? "

Calmly, unhesitatingly, the answer came : " Yes, it is true."

" Then you are only a ——," here a bitter word.

Steadily, with commanding dignity, came the retort : " I believed you were a chivalrous hero. I see you are only a coarse soldier."

Garibaldi flung the garden chair, on which his hand was resting, out of the arbour, strode forth to the stables, had his horse saddled, and, amid the astonished spectators of the scene, dashed away.

The old Marquis, whose name had figured in a new list of Senators, never sat in the Senate House of Italy.

What had happened ? There was another. There always is. . . . He was a dashing young Garibaldian officer, brave, handsome, ardent, Enrico Cairoli by name, whom Giuseppina had met in her patriotic journeyings, one of those sons of Adelaide Cairoli who were to give their lives for Italy—the Signora Cairoli of whom Swinburne sang :

> Four times art thou blest
> At whose most holy breast
> Four times a god-like soldier saviour hung :
> And thence a four-fold Christ
> Given to be sacrificed
> To the same cross and the same bosom clung
> Poured the same blood to leave the same
> Light on the many-folded mountain-skirts of fame.
> . . . . .

Garibaldi always believed that he had been the victim of a political manœuvre, and never forgave Cavour's confidant for the part he had taken in the negotiations. But the expedition of May 1860 was soon in hand, and Garibaldi sailed with the Thousand to win half Italy for Victor Emmanuel.

IV

And Giuseppina ? What of her ? Giuseppina withdrew, the secret locked in her heart, to a dignified retirement. No word of complaint, no word of her wrongs. For twenty long years she allowed gossip, scandal, invention full play as to the nature of her relations with the young Cairoli. Not a word escaped her as to the real cause of the dramatic rupture of the marriage tie in that romantic arbour of the Villa

Raimondi—not a word to friend or enemy. Her silence remained inviolable.

The only mention of Donna Giuseppina in Garibaldi's autobiography relates to the first meeting: "News was brought to me by a beautiful and high-spirited girl who appeared to me like a lovely vision in her carriage."

What was the accusation levelled against her by a handful of Garibaldian officers, and was it true? These officers worshipped their chief, they loved Cairoli, and detested the political intrigue that had entangled their hero; Cairoli also but a short space before they had seen kiss his brother's blood-stained face as he lay, struck down by an Austrian bullet, at his side, and then with a cry of "*Viva l'Italia!*" spring into the hottest of the fight again. Proudly, disdainfully Giuseppina wrapped herself in silence; not even the death of Cairoli, who on the announcement of the betrothal had sought a soldier's death in Poland, and three years later met his end, a prisoner in Siberia—not even the death of her lover drew a syllable from her lips.

V

And Garibaldi? Later, many years later, his service to his mistress, Italy, ended; his gift of a kingdom to his sovereign achieved, Garibaldi, in the solitude of his island home, found the consolation of a devoted companion in the widow of a Garibaldian officer, Francesca Armosino, by whom he had three children. These in his stricken years he was anxious to legitimatise. But what of the still living wife? She also had found consolation, and, to use the discreet words of an Italian writer, had found support on the noble breast of one of the brothers Mancini.

In 1879 both were agreed, and Giuseppina used all her influence to second the efforts of her husband of an hour to untie the legal knot that held them both bound. It was not easy. In July 1879 application was made to the Civil Tribunal at Rome to annul the marriage. The Court decided against the suitors. Garibaldi was furious at the decision, and turned to the young king, Umberto, and to the premier, Benedetto, fifth and last of the Cairoli brothers,[1] asking for an annulment by royal decree or by a special act of the Chamber. While sympathising with Garibaldi, who was nearing his end, they were naturally averse to *brusquer les choses* in that summary fashion. Still, when kings and their chief ministers are agreed, laws go by the board. The most famous counsel of the day in Italy, Pasquale Stanislao Mancini, was consulted, and on January 14, 1880, the Court of Appeal decided that, inasmuch as the marriage took place under the Austrian code, which admitted the nullity of marriages *rati e non consummati*, it was devoid of all legal force. On January 25 Francesca and Garibaldi were made husband and wife at Caprera.

Giuseppina and Garibaldi had never met since that scene in the summer-house at the Villa Raimondi. To the very end Donna Giuseppina held inflexibly to her half a century's self-imposed silence—a striking instance of self-abnegation, moral courage, and fidelity. Stout-hearted, tempered like steel, were those women of the *Risorgimento*.

VI

On a summer's day in 1882 Neapolitan women, rending their hair, had wailed through the streets of Naples, "*È morto Collubardo*[2]*! È morto lu mio bello!*"

On April 28, 1918, the octogenarian Donna Giuseppina passed away near Fino Mornasco almost unnoticed save in a few journals, among them the *Secolo* of Milan, to which the writer is indebted for the chief incidents in her romantic story.

[1] Benedetto, who, in shielding his sovereign from an assassin's dagger at Naples, had been seriously wounded.

[2] *Collubardo* is the Neapolitan equivalent for Garibaldi.

Mental Characters and Physical Characters in Race Study

By H. J. Fleure, D.Sc.

Professor of Geography and Anthropology in the University of Wales

The researches of the last twenty years have shown that when animals with certain definite characteristics breed together, the descendants become in many respects mosaics of inheritance, taking certain characters from the group of ancestors on one side, and others from those on the other. All men are mosaics of this kind, and racial study is beginning to show further that definite alterations of early nurture, as well as other changes, seem to have promoted modifications which have become permanent. The tendency is, therefore, increasingly to think of the unit-character, i.e. a definite characteristic such as height or the colour of the hair, as the important feature to be surveyed and mapped; and a race is thus merely a collection of people who, through similar inheritance and sometimes also, in a lesser degree, through similar modifications, have come to possess a considerable number of unit-characters in common. These characters may have, as it were, crystallised

out in some one region, and the "race" may thus be a group which has arisen from ancestors which may have differed both from their descendants and from one another; but this must not be interpreted too crudely, for all serious study goes to show that many physical characteristics of man are inherited almost unchanged through many generations. Boas's supposition that descendants of immigrants into the United States are speedily modified into a physically distinguishable American type is held to be discarded; his analyses were not adequate to his conclusions.

It is important to keep this picture of "race character" in mind when studying mental characters, because it enables the worker to avoid the extreme view of races as units which have continued unchanged from very early times and have their mark on all the features of all their members, as well as the other extreme view, which looks upon physical characters as fleeting expressions of the influence of the conditions under which a race lives.

The question for study is not so much whether a given race has a certain mentality, as whether physical and mental characters are linked together. This article will try to suggest that they are so linked, but it is well at the outset to note the wish of a cautious psychologist that the question might stand over for another century or two until more is known about mental character. The classifications used in psychological discussions may well be chance combinations and not by any means fundamental unities. For instance, a mental characteristic such as "bad temper" may be a compound of several mental characteristics, which are themselves the true unit qualities of the mind. On the other hand, one might argue that the study of the association of mental and bodily characteristics is as likely as any other line of research to lead to better analysis and determination of fundamental factors. In any case, it is not amiss to try to look out upon a field of scientific study which is as yet hardly touched.

The skin is one organ of contact with the outer world, and its character, colour, and development of its pores and hair in different groups is linked up with circumstances of regions which those groups of peoples occupy. The dark-brown pigment and turgid skin of the African exuding invisible sweat, the dry tough skin of the Eastern Asiatic, the sensitive skin of the men of North-west Europe, the red-brown skin of wanderers on Arctic icefields, are all related to physical conditions—to the glare and heat of the Equatorial regions, the long duration of bitter and dry cold in the interior of East Asia, and so on. But they also imply differences of sense perception, of irritability, and so suggest possibilities of temperamental differences which, especially as between Orientals and ourselves, are very well known.

Again, climate, and especially temperature, has a strong influence on sex-aspects of our organisation. In warm regions sex-maturity is hastened, save among nomads, some of whose males undergo long fasts and other strenuous forms of training. Growth takes on a spurt at the advent of sex-maturity and then ceases. It thus happens that the cessation of growth, at least of mental growth, comes at an early age, before experience has had time to accumulate very much, among the natives of West Africa and the Equatorial forests. And, obviously related to this, is the marked contrast in mental adaptability and power between those natives on the one hand and Western Europeans on the other.

A third point concerning the association of mental and bodily characteristics is brought out when we reflect that most human races are most active mentally when the temperature varies about 60° to 64° Fahrenheit, with occasional short intervals of bracing cold. In those regions in which temperature is for long periods far above or especially far below this level, it is difficult to keep up intellectual initiative unless men are living very protected lives. They tend to rely upon routine even more than we do; the effort of thought is often beyond their physical powers. So the people of certain regions with certain physical characters may tend more towards initiative or more towards ingrained habit according to external circumstances.

Enough has now been said to show that there is a *prima facie* case for the distribution of mental characteristics in particular regions, were we but better able to diagnose them, as well as for certain regional distributions of physical characteristics and for a connection to some extent between one set and the other.

But the case is much complicated by the fact that man is a migratory animal and that, if he moves from one region to another very different one, he by no means discards his old characteristics in the new environment. Migration brings intermixture, and men who migrate make the mosaics of inheritance in a population very complex indeed, so that human organisms are produced with, perhaps, possibilities of differing response to many diverse contacts on the one hand, but with the probability on the other hand of very weak spots when, to put it crudely, the fragments of the mosaic do not quite fit. It is generally acknowledged that the mosaic of inheritance among the Japanese is a very complex one, including elements of very diverse origins. They have demonstrated their educability in a way which has thrilled the world, but they find it very difficult to establish themselves save within comparatively closely restricted climatic limits. In most parts of the world, as a result of

migrations, different types live or try to live side by side, and with differences of physical character we have to consider differences of mental character, as above suggested.

But we must beware of treating all that we consider to be mental character as rigidly bound up with racial physical character. A great majority of the Welsh people has a natural gift for vocal music; oratory is widespread and may often be of high character; the poetic gift is frequent; but there is little Welsh architecture or purely Welsh painting. Interest in vocal music and weakness in painting may also be said to be features of Swiss life. The physical racial characters of most Swiss people differ very deeply from those of most Welsh people, and these physical characters cannot be invoked for interpreting some partial similarities just noted in mental affairs. We are, rather, face to face with certain reactions to conditions of life which, in both cases, rather limit the opportunities and the equipment for artistic expression along lines needing wealth for their development. But while allowing full weight to this kind of interpretation, we need not forget that hill-life with its shepherding has a musical tradition that is world-old, and that it encourages lung development as well. Again, the post-classical development of the arts of painting and sculpture has been most notable in the Italian cities of the Renaissance and in Flanders, both, at the time of their artistic flowering, foci of intercourse on a large scale and regions of accumulation of wealth. Opportunity would seem to have been a bigger factor here as well.

Nevertheless, in spite of all that may be said for influence of circumstances acting directly or indirectly, a good deal may also be claimed for the influence of race inheritance, even if it be freely admitted that the race character may possibly be the expression of the exposure of many generations to the influence of similar conditions, a character capable of change with changed conditions.

It is claimed that the prime home of the agricultural village-community, with its system of common fields and governance by custom, is the region on the north side of the Alps—a region where the simpler folk, at least, are of Alpine race. The system is usually thought to have been weak when transplanted among other peoples. The same area is noted for small industry, based on wood from the forests and winter leisure no doubt, but developed along lines requiring patient application and refined handling; the watch-making industry and the modern electrical-machinery industry have closely similar distribution and seem to depend on the same patient tenacity and love of detail. The complex workmen's insurance schemes, the public ownership of services of many kinds, the concentration on local interests and disregard of large ambition, are all features of the same people. Thence we get a picture of some aspects of mentality very common, not of course universal, among people of Alpine race in Western Europe, that is, among the stocky, round-headed, round-faced, rather dark people who form a large proportion of the population of lands on the north side of the Alps, as well as of certain parts of France.

One might argue about characteristics widely distributed among the Chinese and so on, but this argument from observation in the mass is far less interesting than argument based on a finer analysis, for which purpose it will be best to consider a few varieties in the British population.

Without repeating here an argument often worked out, it may be said that the basis of the population of England and Wales has the following characters present in a large number of individuals: The head is long and the body is bony, rather than thick-set or fleshy; the stature is very often low, but varieties are decidedly tall; the colouring is dark, as regards the hair at least, though the eyes are grey in many cases. It is a type produced in all probability by descent with modification from the early Neolithic people of the country, though many subsequent migrants, both from the south and from the north-east, may have contributed to it. In Wales it runs darker and smaller, and so it does in Derbyshire, north Hertfordshire, Dartmoor, and elsewhere.

In Wales its representatives will be found in force at religious gatherings, Eisteddfodau, and the like. In the villages among the hills they live poorly on tea and bread and butter, with dire consequences to their health. House-pride is not at all well developed, nor is there much gardening instinct present. They may flee from rural poverty to the mining and industrial areas, where, with more food, they seem uniquely able to survive slum conditions, though they do this at the cost of much warping of fine nature, which made a gentle courtesy a widespread feature of their rural life.

It is the people who possess these physical characters who therefore suffer exploitation by the industrial system, and that system is most probably spreading these characters at the expense of all others throughout the less-privileged ranks of society. A sympathetic psychological study of these people and the conditions that favour their development might do something to limit human devastation due to mass-production based on irresponsible speculation. In the remoter corners of Britain it would seem that there linger in the minds of these people strange elements or faculties which, in our deep ignorance, we call " second

sight" and the like. The student will reflect that these and other items of mental equipment might really be or become channels to fuller apprehension of truth, though conditions of life, especially in industrial areas, seem to have almost destroyed them.

Contrasted in almost every way with the dark longhead is the tall, long-headed blond, though here again we must remember that there are marked variations under different circumstances. In the English countryside these characters are found among the few remaining landed families of the pre-industrial age; they are noteworthy in certain clans, among the gamekeepers and poachers of the wilder parts of the country, and in certain fishing populations. They are numerous among the lower ranks of army officers. Their antipathy to slum life is notorious, and mass-production, by easing communication, has given them an escape to the new lands, where they find room and adventure, though it is not yet certain that they can go on reproducing their kind in some of these lands. That initiative and restless energy are a feature of mental equipment associated with these physical characters seems clear enough. Bloodthirstiness also has been ascribed to the "blond beast" by many a writer, but the Scandinavian blond has been peaceful enough for longish periods, and the tendencies to war fever may often be encouraged by inhibitions of that energetic initiative in a complex social order little understood by simple outdoor minds.

The British population shows in certain families and a few districts a group of very marked physical characters—the head is broad and the forehead large and receding from mighty brows, the face is often strongly marked, the colouring inclines to the fair side, and the stature is tall, even at times very tall. These characters, so far as they can be judged from skulls, and others too detailed to mention, are also found in the remains of certain invaders of Britain who reached its eastern shores about the end of the Stone Age, after having spread westward into Europe along the belts of loess and related deposits (comparatively forest-free) north of the Alps. Whether our modern representatives descend from those who arrived so long ago or from other possessors of like characters who have come since we have no means of telling, but we do know that these characters are handed down very clearly in certain families. What of the mental characteristics possibly associated with them? These physical characters will be found fairly commonly in such gatherings as a congress of surgeons, or a meeting of serious administrators, or among office-holders with important synthetic tasks. One frequently notes among the possessors of these physical features the power to gather up many threads of evidence and to weave them together with imaginative skill. The energy to carry out a scheme thus made may or may not be present, and the moral courage to do battle for it may not always be found. But the men with these features are often gifted with much political sense, and the John Bull of British caricature belongs here just as decisively as the Englishman lampooned in Continental cartoons is attributable to the taller variety of the dark, bony longhead discussed in an earlier paragraph.

Certain coastal patches of West Britain show a proportion of dark-haired people with broad, squarish features of head and face and very strong build. They lack the strong brows of the people previously discussed, and they are more variable in stature, though they are also often very tall. Similar characters are found among the people of coastal patches here and there in Spain, Brittany, the Hebrides, etc. In nearly every case these districts are interested in merchant shipping or in long-distance commercial fisheries. These physical characters are also often found among business men and financiers, notably in maritime marts of the Mediterranean Sea.

It would be interesting to discuss the red-haired strains, the admixtures of Jewish blood, and so on, but the above must suffice as examples. In each of the cases quoted there is thus *prima facie* evidence of the association of grouped physical characteristics on the one hand with certain mental activities on the other. That is as far as it is possible to go with any profit at this early stage. It should be noted that there is no intention to argue from any one physical character to any one mental character, or *vice versa*. Nor is there any wish to argue that the mental characters are in a sense "caused by" the physical ones with which they seem linked. A group of physical characters taken together, it is suggested, is at times linked up with certain manifestations of mental activity, though, in all probability, the linkage is by no means invariable, and at least allows of considerable variation as regards energy and exactitude. The particular manifestations of mentality from which we argue may be bound up with social circumstance, but behind them are probably real dynamic factors which we as yet barely apprehend.

This short article may be too compressed to do more than suggest an outlook upon a region still uncharted by science, but it may nevertheless have served some more directly useful purpose if it has drawn attention to the folly of treating of the mental characters, be it of Germans, Frenchmen, or Britons, in the mass. In each national group are many racial mosaics, and similar groups of characters occur in all. There are differences of social expression and lack of expression connected with social and historical facts, and these are apt to vary from

century to century. Yet somehow behind all this are correlations of physical characters with psychical characters with which we are as yet almost unable to deal scientifically, for we see but certain manifestations and hardly know anything about their mental springs.

The Plundering of the Royal Tombs at Thebes in the Twentieth and Twenty-first Dynasties

By Aylward M. Blackman, D.Litt.

All the world is now talking of Lord Carnarvon and Mr. Howard Carter's great discovery in the Valley of the Tombs of the Kings at Thebes. It occurred, therefore, to the writer that readers of Discovery might be interested to hear something about the disasters that befell the Theban tombs and their occupants under the later Ramessids of the Twentieth, and the Priest-Kings of the Twenty-first, Dynasty (about 1150 to 940 B.C.)—disasters in view of which the discovery of Tutankhamon's tomb in a practically unplundered condition will appear all the more marvellous, a thing beyond the dreams of archæological avarice !

With this end in view, the article will deal for the most part with a group of documents, all of which were written during the years 1120–1123 B.C., the sixteenth to nineteenth years of Ramesses IX, the last but three of a long line of decadent descendants of the great Emperors, Ramesses II and III. Of these documents the most important, for our purpose, is the so-called *Abbott Papyrus*, now preserved in the British Museum. Recourse will also be had to two papyri in the Free Public Museums at Liverpool, the so-called *Mayer Papyri A & B*, recently published, with accompanying translation and explanatory notes, by Professor Peet, as well as to a fragmentary but important papyrus in the Amherst Collection, and to one other, equally fragmentary, to be found in the world-famous collection of Ancient Egyptian manuscripts preserved in the Museum at Turin. All the documents in question are closely interrelated and, scattered now though they be, undoubtedly belong to a single "find." Originally they must have been included among the vizierial archives of the Twentieth Dynasty.

Thebes in the Twelfth Century B.C.

At the time when these documents were drawn up the governorship of Thebes, still the capital of the now much shrunken Egyptian Empire, was vested in the vizier, the Pharaoh's prime minister. But for ordinary administrative purposes the city was divided into two parts, the one lying on the east, and the other on the west, bank of the Nile, and either under its own mayor, or *'omdah* as he would now be called. The eastern half was the main city, containing as it did the business and residential quarters, and also the two great temples of "Elect-of-Places" (Luxor) and "Thrones-of-the-Two-Lands" (Karnak). The western city, to which was attached the vast Theban necropolis, was in the main, so it would appear, given up to the officials great and small, and to the countless host of artisans and the like, whose business it was to look after the necropolis and to manufacture and supply all the elaborate funerary equipment, with which the upper- and middle-class Egyptian wished to be furnished at his burial. Here also were the workshops and the residences of the embalmers.

The *Papyrus Abbott* informs us that the then mayor of eastern Thebes was a certain Peser, the mayor of western Thebes bearing the name of Pewer'ō. Peser does not appear to have been on very good terms with his colleague across the river ; indeed, we gather that their relations with one another were distinctly strained.

Some time before the period with which we are concerned Egypt had lost her hold on her one-time Asiatic dominions, while at home the central government itself had begun to weaken and to disintegrate. By the time that Ramesses IX had succeeded to the throne of his fathers, things had got into a very bad way indeed. Existing records hint at internal troubles caused by, or accompanied by, an intrusion of foreigners. No doubt owing to the disturbed political condition, the necropolis workers were not receiving their wages, which were issued in the form of grain and other food-stuffs, and they were accordingly in a continual state of starvation and its concomitant unrest. The host of workers had to live somehow, and there within easy reach of them lay untold wealth buried in the tombs of the kings and of the nobles, the accumulation of five hundred years or more. In the circumstances it is not surprising that the ill-paid furnishers and guardians of the dead took to plundering their helpless charges, the higher officials of the necropolis, probably thoroughly corrupt themselves, being apparently quite powerless to stop the looting that soon began to take place on a large scale.

A Tale of Two Rival Mayors

This was the state of affairs in the sixteenth year of the reign of Ramesses IX, when Peser and Pewer'ō were mayors respectively of eastern and western

Thebes. Peser, having acquired information with regard to the plundering of certain royal tombs, as well as of a large number of tombs of nobles and others, naturally thought that here was the chance of a lifetime to bring about his hated rival's downfall. He accordingly passed on the information to the vizier, Khamwēse by name, his own and Pewer'ō's superior. Evidently Pewer'ō was requested to furnish the vizier with an explanation concerning the charges brought against him, for the *Papyrus Abbott* informs us that this official himself "reported to the vizier, the nobles, and butlers of Pharaoh" concerning the tomb-robbers.

After thus hearing both accounts, the vizier sent a commisson to western Thebes to inspect the necropolis.

FIG. 1.—GILDED AND INLAID BOX FOUND IN THE TOMB OF IUYU AND TUYU, THE PARENTS-IN-LAW OF AMENŌPHIS III.

The commission, which made this tour of inspection on the 18th day of the month Ḥatḥor, found that all the tombs of the nobles and lesser personages enumerated by Peser had been broken into, and the report drawn up by the commission tells us that "the thieves had pulled the occupants (of these tombs) from their coverings and coffins, they (the mummies) being thrown on the ground; and that they had stolen their articles of house-furniture (cf. Figs. 1, 2, and 3) which had been given them, together with the gold, the silver, and the other ornaments which were in their coverings." However, so far as the royal tombs were concerned, the state of affairs was apparently not so serious as Peser had maintained. Of the ten kings' tombs inspected by the commission, one only is stated in the report to have been plundered, while two had been unsuccessfully tunnelled into by the robbers. However, the plundered tomb, that of the Thirteenth-Dynasty Pharaoh, Sebekemsaf, and his wife Nubkhas, had been completely looted. Luckily for him, no doubt, Pewer'ō managed to arrest the robbers of Sebekemsaf's tomb, and a list of their names was submitted to the vizier.

What the Thieves found in Sebekemsaf's Tomb

Accordingly on the next day, the 19th of Ḥatḥor, the vizier Khamwēse and a number of his subordinates examined the eight men accused of this crime, "and the manner in which the thieves had laid their hands upon the king and his royal wife was ascertained." A portion of their full confession, dragged out of them, no doubt, after a severe beating and under threats of further torture, is preserved to us in a fragmentary document in the Amherst Collection. The description of how the robbers broke into the tomb is unfortunately lost, the first really intelligible passage describing their coming upon the sarcophagus of the queen within the actual burial-chamber. "We penetrated them all (doubtless the thieves are speaking of a series of chambers and passages leading one into another), we found her resting likewise. We opened their coffins and their coverings (i.e. the inner coffins) in which they were. We found this august mummy of the king. . . . There was a numerous array of amulets and ornaments of gold at its throat; its head had a mask (?) of gold upon it; the august mummy of the king was overlaid with gold throughout. The coverings were wrought with gold and silver, within and without; inlaid with every splendid costly stone. We stripped off the gold which we found on the august mummy of this god, and its amulets and ornaments which were at his throat, and the coverings wherein it rested." The thieves then go on to say how they stripped the body of the queen in like manner, and how finally, to complete their work of destruction, they set fire to "the coverings." With the mummies of the king and queen they found a number of gold, silver, and bronze vases, of which they took possession, and as for the gold which they found on the mummies and on their "coverings," they divided it into eight parts.

A Suspected Coppersmith "Examined"

On the same day, Ḥatḥor 19th, another judicial investigation was also undertaken by Khamwēse and his assistants. It was a proceedimg of great interest for us moderns, for it partook of the nature of a reconstruction of the crime, a feature of French judicial inquiries in criminal cases. A certain coppersmith, Pekharu by name, was among those accused by Pewer'ō of tomb-robbing. Probably in order to avoid further beating, he had confessed to having been in the tomb of Queen Īse, a wife of Ramesses III, and to

having carried a few things out of it and taken possession of them. Khamwēse had the man led blindfold to the neighbourhood of the tomb in question, and upon

FIG. 2.—GILDED COUCH WITH PANELLED HEAD-PIECE FOUND IN THE TOMB OF IUYU AND TUYU, THE PARENTS-IN-LAW OF AMENŌPHIS III.

arriving thither his eyes were uncovered. "The officials then said to him: 'Go before us to the tomb, from which you said: I carried away the things.'" The coppersmith led the way to a tomb that had never been in occupation and to the hut of a certain workman of the necropolis, and ejaculated: "Behold the tomb in which I was." The officials were not to be put off by what, after all, might be assumed ignorance and stupidity, so he was there and then subjected to "a severe examination in the great valley," but "he was not found to know any place there, except the two places upon which he had laid his hand. He took an oath of the king, that he should be mutilated by the cutting off of his nose and ears and be placed upon the rack if he lied, saying: 'I know not any place among the tombs, except this tomb which is open, together with the hut upon which I have laid your hands.'" What then befell the unfortunate coppersmith we are not told, but we may hope that he was subjected to no further "examinations," and was set at liberty.

The events of the day concluded with the inspection of another part of the necropolis, wherein the families of the Pharaohs were laid to rest, called "The-Place-of-Beauty," and here *all* the tombs were found uninjured.

A Demonstration by the Western Thebans

Regarding the safekeeping of the royal tombs as far and away the most important part of their duties, the head officials of the necropolis held, or pretended to hold, the view that the findings of the commission, and what the vizier had himself discovered as the result of his personal inspection of that very day, afforded a complete proof of the soundness of their administration. Accordingly the same evening they made a crowd of lesser officials and workpeople of the necropolis cross over to the eastern city "as a great deputation," in other words to demonstrate, and noisily to celebrate the triumph of the western over the eastern mayor. Peser had gone out that evening, possibly to discuss in a friend's house his failure to encompass his hateful colleague's downfall, and was returning home in the company of Nesiamūn (a butler of Pharaoh and one of the officials who had accompanied the vizier on his tour of inspection earlier in the day), when he encountered the "deputation" in the act of demonstrating in front of the door of his house. Peser does not seem to have been a very discreet person. He instantly lost his temper, began soundly to rate the leaders of the demonstration, and uttered a number of vague threats against them and their superior officers. "As for this deputation which you have sent," he bawled, "it is no deputation at all! It is just your jubilation which you have made!" The infuriated mayor then "took an oath of the king in the presence of the butler of Pharaoh (Nesiamūn), saying: 'The scribe of the necropolis, Ḥerishēre . . . and the scribe of the necropolis, Pebes, have told me five very serious accusations worthy of death against you. Yea, I am writing concerning them to Pharaoh, my lord, that a man of Pharaoh may be sent to take you all in charge.'"

All this was duly reported to Pewer'ō, who next day, Ḥathor 20th, wrote a letter to Khamwēse complaining of Peser's conduct. This letter recounts how "the king's butler Nesiamūn happened by, when the mayor of the city, Peser . . . stood quarrelling with the people of the necropolis." Peser is reported to have said: "Ye exult over me at the door of my house! Oh, indeed! Albeit I am the mayor who makes report to the sovereign. And so ye exult over him!" Peser then

FIG. 3.—CARVED AND GILDED CHAIR, WITH ITS LEATHER CUSHION, FOUND IN THE TOMB OF IUYU AND TUYU, THE PARENTS-IN-LAW OF AMENŌPHIS III.

becomes sarcastic. "Ye were there! It (the cemetery) was inspected! Ye found it uninjured! Yet the tomb of King Sebekemsaf and (that of) Nubkhas his royal

wife were broken into! A member of "the deputation" began to remonstrate with the mayor. "All the kings," he asserts, "together with the royal wives, royal mothers, and royal children, who rest in the necropolis, together with those who rest in 'The-Place-of-Beauty,' they are uninjured, they are protected and defended for ever." To this Peser said: "Pooh! Are your deeds as great as your speech, pray?"

Pewer'ō's account of the sayings and doings of his rival and "the deputation" is here interrupted by a comment of his own on the accusation brought against himself and his subordinates in this outpouring of the vials of Peser's wrath upon the demonstrators. "This is indeed no little word that this mayor of the city spake." Pewer'ō then gives a version of what Peser was reported to have said in the matter of "the five serious accusations," accusations which, as we have already learnt, had been made to Peser by the two scribes of the necropolis Ḥerishēre and Pebes, and which, Pewer'ō tells us in his letter, Peser also claimed to have had put down for himself in writing by his private secretary and the scribe of the two districts of the city. "I heard the words which the mayor of the city spake to the people of the great and august necropolis of millions of years," Pewer'ō goes on to say, "and I report them to my lord (the vizier), for it were a crime for one in my position to hear such words and conceal them. I was not able myself to apprehend the very serious words which the mayor of the city spake; the scribes of the necropolis who stood among the people told me, but my feet were not present with them. I report them to my lord, that my lord may bring in one who actually apprehended the words which the mayor of the city spake, and the scribes of the necropolis told me." Pewer'ō waxes indignant over the conduct of Ḥerishēre and Pebes. "It is a crime," he says, "of these two scribes that they should have applied to this mayor of the city, to report to him." Their business was to have "reported to the vizier." Pewer'ō concludes his letter by saying that he has had the whole matter laid before the vizier in writing so that those who actually heard Peser's speech "may be summoned for to-morrow."

Pewer'ō Vindicated by a Judicial Inquiry

Accordingly the next day, Ḥathor 21st, the vizier instituted a judicial inquiry as to the truth of Peser's allegations. The presiding judge was, of course, the vizier himself, with whom were associated as assessors, besides several others, the king's butler Nesiamūn—one has considerable doubts about that gentleman's loyalty to his apparent friend Peser—and the luckless Peser himself. According to the statements of the vizier in his address to the court, the persons accused by Ḥerishēre and Pebes to Peser were three coppersmiths in the employ of the High Priest of Amūn, the accusation being that they had rifled "the great seats" (the royal tombs) in "The-Place-of-Beauty"—the very part of the necropolis that the vizier and his associates had inspected only the day before. "Now I, the vizier of the land," said Khamwēse, "have been there with the king's butler Nesiamūn, the scribe of Pharaoh. We inspected the tombs where the mayor of the city said the coppersmiths . . . had been. We found them uninjured, and all that he (Peser) had said was found to be untrue. Now, behold, the coppersmiths stand before you; let them tell all that has occurred." The document tells us that the coppersmiths were examined, and that "it was found that they did not know any place in the seat of Pharaoh (the necropolis) of which the mayor had spoken the words." Accordingly Peser "was found wrong therein," and the coppersmiths were "granted life" and handed back to their master, the High Priest of Amūn.

Thus ended the attempt of Peser to get Pewer'ō deposed. Whether he paid the penalty for losing his case by being deprived of his official position, we do not know.

But despite Khamwēse's vindication of Pewer'ō's administrative abilities, and his refutation of Peser's charges against the coppersmiths, all was by no means well in the necropolis. In the first place, as we have seen, all Peser's statements with regard to the tombs of certain nobles and others, situated in a particular part of the cemetery, were verified, and one royal tomb had been completely looted. Moreover, a fragmentary document in the Turin Museum, dated the 22nd day of Phamenoth in the seventeenth year of the reign of Ramesses IX—the year after that in which the inquiry was held as to the truth of Peser's charges—affords us good grounds for supposing that, though the coppersmith Pekharu was rightly acquitted of the charge of having robbed the tomb of Queen Īse, yet the tomb had actually been plundered before the vizier and Nesiamūn inspected it! These two must have made a very careless inspection, or else, for some reason or other, they closed their eyes to the truth of the situation. One wonders whether they had both had their palms well greased by Pewer'ō. . . .

The above-mentioned Turin papyrus informs us that the vizier Khamwēse, and the workmen of the necropolis and their overseers, went to inspect the tomb of the king's wife Īse. They found that the tomb had been plundered and that even the royal mummy had been damaged, the authors of the mischief, be it noted, being designated "the eight thieves." As Breasted maintains, "these can hardly have been other than the eight thieves of Sebekemsaf's tomb, who must have robbed the tomb of Īse before their arrest in the year

16."[1] We may well believe, therefore, that Peser's charges against Pewer'ō were anything but groundless, and that the truth of them was being gradually forced upon the vizier. Perhaps the maladministration of the necropolis by Pewer'ō had become so notorious a fact that even heavy bribery could no longer make it worth the vizier's while to continue his policy of hush—he may have come to realise that to go on like this would lose him his viziership.

Later Robberies

But thanks to the stupidity or roguery of Khamwēse's initial policy, Pewer'ō's disgraceful incompetency, and the utter inability of the central government to cope with any situation that demanded instant and firm action, the plundering still went on. Thus four accounts of trials of tomb-robbers, three dating from the nineteenth year of the reign of Ramesses IX, are preserved to us in the *Mayer Papyri A & B*. These accounts inform us fairly completely as to how the trial of persons accused of such criminal offences was conducted. They were first examined by beating with a rod, their hands and feet were fettered, and an oath was administered to them not to speak falsely. Then their deposition was taken down. If, after being thus beaten and fettered, the accused still maintained his innocence and apparently could reveal nothing, and other serious evidence against him was not forthcoming, he was declared innocent and set at liberty.

Articles of Spoil Most Favoured by Thieves

Two passages, one in the *Mayer Papyrus A* and the other in *B*, tell us what sort of loot the ancient tomb-robbers were out to obtain. From the tombs of a certain Queen Nesmut, Queen Bekurel (wife of Ramesses VI), and a person whose name is not recorded, the thief Bukha'ef got 3 *deben* (about 273 grammes) of silver, 150 *deben* (13,650 grammes) of copper in the form of vessels, 1 *deben* (91 grammes = about 3 oz.) of gold, a necklace of gold weighing 8 *kite* (72 grammes = more than 2 oz.), and a number of garments, some of coloured cloth (or perhaps rather cloth embroidered in divers colours), and others described as being of fine Upper Egyptian cloth. In the other passage a witness tells us how he and four others robbed the tomb of Ramesses VI. He relates how, after spending four days in breaking into it, they at last succeeded in opening the tomb and entered it. He speaks of their finding a basket, and apparently also some sixty chests or boxes. They opened the basket and found in it various bronze and copper articles, wash-basins, ewers, and vases of different kinds, weighing in all 500 *deben* (45,000 grammes = 1 cwt. 21 lb. 4 oz. 15 dwt.), which they divided into five equal shares of 100 *deben* in weight. They also opened two boxes full of clothes, the boxes very possibly being more or less like that shown in Fig. 1. Among these clothes were coloured or embroidered robes and garments of good Upper Egyptian cloth, in all thirty-five garments—seven, therefore, falling to the share of each thief. They opened yet another basket, this time containing not bronze and copper articles but clothes—and here, alas! the document abruptly ends, the rest being torn off and lost. So we shall never know what other treasures these thieves found in the tomb of Ramesses VI and carried off.

[1] Breasted, *Ancient Records of Egypt* (Chicago, 1906–7), vol. iv, §§ 502, 542.

The Treasures in Tutankhamon's Tomb

It is just such objects as those described in the preceding paragraph that have been found in the newly discovered tomb of Tutankhamon. The accounts hitherto published speak of boxes, baskets, and vases, as well as of splendid furniture overlaid with gold and inlaid with ivory and brilliantly coloured glaze plaques. According to the account in *The Times*, included among the great array of costly furniture are several gilded couches, which are no doubt much like that shown in Fig. 2. Mention was also made in *The Times* of cushioned chairs. Such a chair, elaborately carved and gilded, with its leather cushion, is depicted in Fig. 3.

By the time the reign of the last of the Ramessids came to an end, there were few royal tombs left to plunder. Paynozem I, the third king of the succeeding priestly dynasty, gave up in despair the task of attempting to protect the royal sepulchres, and started transferring the bodies—the rich tomb-furniture and burial-outfit had long ago vanished—to the tomb, so well known to tourists, of Sēthos I. During the reign of Siamūn, next king but one to Paynozem, the bodies of Sēthos I, Ramesses I, and Ramesses II, were taken from the tomb of Sēthos I to that of a queen called Inhapi. But even here they were not safe from the marauder's hand, and finally, a few years later, under Pesibkhenno II, they, and the bodies of a number of other royal and highly placed personages, were secretly conveyed to an old and probably unused tomb of Amenōphis I, near the temple of Deir el-Baḥri. The entrance to this tomb was finally sealed up early in the Twenty-second Dynasty, not long after 940 B.C. "Here," says Breasted, "the greatest kings of Egypt slept unmolested for nearly three thousand years, until about 1871 or 1872, when the Theban descendants of those same tomb-robbers, whose prosecution under Ramesses IX we can still read, discovered the place, and the plundering of the royal bodies was begun again. By methods not greatly differing from those employed

under Ramesses IX, the modern authorities forced the thieves to disclose the place. Thus, nearly twenty-nine centuries after the first interment of the earliest among them, the faces of Egypt's kings and emperors were disclosed to the modern world."[1]

Lord Carnarvon and Mr. Howard Carter's discovery would in any circumstances have been regarded as of immense importance, both from the historical and the artistic standpoint ; but to one who keeps before his mind's eye the history of the Theban necropolis—one long tale of plunder and destruction—to such an one the value of the discovery and the good-fortune of the discoverers seem things that it is scarcely possible to over-estimate.

Artificial Light—its Production and Application

By J. S. Dow

Among the advances of the past century few are more remarkable than those associated with the production and application of artificial light. In these days of abundant illumination we can hardly picture the limitations imposed by inadequate lighting in the past. Not only is light far more abundant ; it is also much cheaper than in the days when only oil-lamps and candles were available. We are still accustomed to think of the wax-candle as the poor man's illuminant. We forget how feeble is the light it yields. It has been calculated that the cost of 1,000 candle-hours yielded by a wax-candle is approximately 12*s.* 6*d.*, whereas with modern electric lamps we can obtain the same output of light at less than the cost of one unit of electricity, say about 6*d.* Some of the principles underlying the production of light, and our hopes of future progress in this respect, may therefore interest readers of Discovery.

Incandescent Lights

Hitherto illuminants have been based mainly on *incandescence*. We heat up a solid substance until forced vibrations of the crowded electrons take place, and amidst the jumble of radiations emitted a small portion is perceived to be luminous. Even the most efficient incandescent illuminants only emit in the form of visible light a very small proportion (probably not exceeding about 5 per cent.) of the energy supplied to them. The remainder is chiefly useless heat-energy.

[1] Breasted, *A History of Egypt* (London, 1906), pp. 552 foll.

Now it was shown long ago by Planck, Lummer and Pringsheim,[2] and others that as the temperature of incandescence rises, so the proportion of visible radiation emitted by a " black body " increases. It has been calculated that at the temperature of the sun as much as 50 per cent. of the radiation might be emitted in a luminous form. Therefore attempts have been continually made to increase the temperature of the incandescent illuminants. The higher temperature attained in the tungsten filament nearly trebled the efficiency of the carbon filament lamp ; in the gas-filled (" half-watt ") lamp it was again found possible to double the efficiency by running the filament at a still higher temperature. Similar recent advances in the efficiency of incandescent gas burners are based mainly on securing more complete combustion, a hotter flame, and higher luminosity of the mantle. In ordinary artificial illuminants we have not yet been able to attain the temperature of the

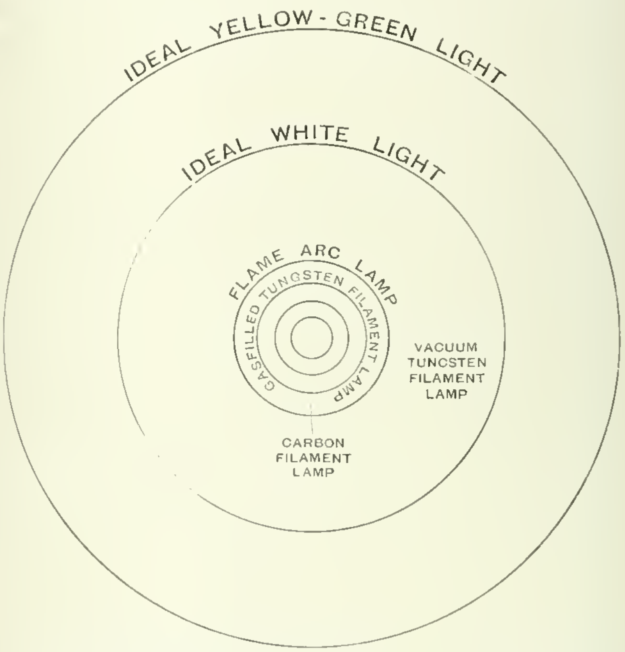


Fig. 1.—The areas of these concentric circles represent the approximate luminous efficiency of various sources of light, as follows :

Source.	Candle-power per Watt.
" Ideal " Yellow-Green Light	65
" Ideal " White Light	26
Flame Arc Lamp	4–5
Gas-filled Tungsten Filament Lamp	1·5–2
Vacuum Tungsten Filament Lamp	0·75–1
Carbon Filament Lamp	0·25–0·35

sun. But Lummer,[3] working with an arc between carbon electrodes—the same principle as that employed in arc lamps for street and shop lighting—but under very high pressure, is stated to have obtained a crater-

[2] For a summary of these and other researches see *Praktische Photometrie*, by Dr. E. Liebenthal, pp. 43–55.

[3] *Lichttechnik*, by L. Bloch, p. 113.

brightness exceeding 1,000,000 candles per sq. in., and a temperature of 7,600° abs.—probably the highest temperature yet attained by artificial means.

However, even assuming that such a temperature could be obtained in a commercial illuminant, we should still, apparently, only usefully employ about half the energy as light. But there is another possibility of improvement. These data are calculated for conditions where the substance heated to incandescence is black in colour. But it is believed that white or grey materials may exercise " selective radiation," i.e. emit a higher proportion of radiation in a luminous form than that derived from a black body at the same temperature. The incandescent mantle and the glower of the Nernst lamp exhibit selective radiation in some degree, but, generally speaking, the effect is not very pronounced in solid illuminants.

FIG. 2.—SHOWING SOME EXPERIMENTAL NIGHT-LIGHTING AT THE CROYDON AERODROME

One of the special lighting units, introduced by Major J. P. Ashley Waller, is to be seen on the left. This is mounted on a tripod and utilises a 1,000-watt gas-filled electric lamp, equipped with a dioptric refractive lens to concentrate light below the horizontal and evenly illuminate the ground surface. The photograph was taken entirely by the light of two of these units, and the buildings are seen to be brightly illuminated.

Luminescence

In order to obtain more definite selective radiation, and so avoid the energy-waste of heat, we may excite metallic vapours or gases by an electric discharge—a process which is termed " luminescence." The mercury vapour lamp and the flame arcs cored with suitable metallic salts are instances of luminescence, and are comparatively efficient sources of light. The new " Osglim " lamps, utilising the orange glow of rarefied neon gas when subjected to electric discharge, again illustrate the same effect. But this method of producing light, while conducive to higher efficiency, has its drawbacks. One does not obtain a continuous spectrum, but only light of selected wave lengths. Since the colour of light is determined by the length of the ether-waves which cause the light, it may be of peculiar colour—illustrated in the complete absence of red in the light of the mercury lamp, and the deficiency of green, blue, and violet in that of neon lamps. The colours of objects illuminated by such sources are naturally much distorted.

Can more Efficient Illuminants be Produced ?

At present, therefore, we are only feeling our way towards complete success in light-production. For most purposes we require an approximately white light giving to objects around us their true colours. If we could devise an ideal source yielding white light, and no useless invisible radiation such as heat, it might yield as much as 26 candle-power per watt, or unit of energy—a value about six times as high as that of the most efficient illuminant at present available.

This, however, by no means exhausts the possibilities of research. There are cases (for instance in lighthouse work) where we are indifferent to colour and only wish to produce maximum brightness. Now the radiation in the extreme red and violet of the spectrum are barely visible, and the great impression of brightness is produced by the yellow-green, in the middle of the spectrum. If our source of light yielded only light of this wave-length, it might give us 55 or even 65 candles per watt. This would apparently be the ideal from the pure standpoint of brightness. The goal may be reached by research from some unexpected

direction, such as the synthetic production of phosphorescent substances, resembling those met with in nature in the firefly, which yields a light without perceptible heat, and is believed to attain an efficiency approaching 100 per cent. All the energy expended by the firefly in the process appears as light.

Artificial Daylight

Another problem with which physicists are at present struggling is the production of "artificial daylight," namely an artificial illuminant yielding light which in colour almost exactly resembles that received from a white north sky. Such a source would prove of inestimable value in many industries involving accurate colour-matching processes. Lamps for use in this way have recently been introduced, and it appears that already natural daylight can be imitated with very fair accuracy. But at present this can only be done by a "subtractive" method. Light from a gas filled electric lamp is modified, either by transmitting it through a sheet of tinted glass (such as that introduced by Chance Bros. & Co.) or by reflecting it off a specially coloured surface (as in the Sheringham Daylight). Such methods inevitably involve waste of light, which may be as much as 60 per cent. Notwithstanding this loss, such lighting units have considerable value. But our ultimate aim should be to produce directly light from all parts of the spectrum to produce the desired "white light," so that no extraneous modifying device, involving absorption, is needed.

Advances in Application of Artificial Light

Hitherto we have spoken chiefly of advances in the production of light. But advances in its application have been equally important. These applications have been made the subject of study by the Illuminating Engineering Society for the past fourteen years, and we now understand much better how light should be applied in the home, and in schools, streets, factories, etc. In particular we have learned how to measure illumination by means of convenient portable apparatus, and thus to evolve standards for various purposes. Great progress has been made in methods of directing light. In some cases, e.g. in illuminating a picture or "flood-lighting" the exterior of a building, we aim at furnishing even illumination over a vertical surface. At other times, in illuminating, for example, the landing area at an aerodrome, our object is to distribute light over an extensive horizontal area. In the searchlight, on the other hand, we have an entirely different problem, that of concentrating all the available light within a very small angle. By such concentration a beam of enormous candle-power may be obtained. A lighthouse recently installed on the French coast is credited with emitting a light of 1,000,000,000 candle power.

In the motor car headlight we have another instance of judicious direction of light. The problem of combining sufficient power of beam to reveal distant objects, with absence of glare to approaching drivers or pedestrians, appears almost insoluble. But many ingenious devices for confining most of the light below a horizontal plane under the eye-level, and for distributing it evenly along the road, have been introduced.

The Kinematograph Projector

In the kinematograph projector there is another opportunity for the exercise of ingenuity by inventors. Notwithstanding all that has been done to improve the mechanism of the kinematograph, the projecting apparatus is still very wasteful of light. It has been estimated that only about 1 per cent. of the light emitted by the arc actually reaches the screen. And even the light which forms the picture is not all usefully applied, for much of it is reflected towards the walls and ceiling and never meets the eyes of the audience.

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Between the Covers

THE WOMEN OF GREENLAND AND THEIR DRESS

In our September and October numbers last year we published two papers on Greenland by Professor A. C. Seward, F.R.S., who made personal investigations of the fossils and plant life of that Arctic continent during the summer of 1921. Professor Seward has now published a fuller account of his geological and botanical investigations, together with a description of his experiences, and impressions of the scenery and the natives on the west coast, under the title of *A Summer in Greenland* (Cambridge University Press, 7s.). He records some interesting facts concerning the women of Greenland and their dress: "It is the duty of Eskimo women to skin and cut up the seals, and this is performed with wonderful dexterity by

the aid of a simple knife with a semi-circular blade attached to a broad wooden handle. It is said that a woman dressed in her best can cut up a seal without receiving a single splash of blood.

"The chief recreation is dancing. I recall one evening at Holsteinsborg on the mainland coast when we danced in the open until midnight to the accompaniment of a concertina played with great skill by a Greenlander.

"The women, like the men, wear hairy seal-skin trousers, but the women adorn theirs with a band of white or coloured skin on the front of each leg; the boots, made of seal-skin from which the fur has been removed, reach to the knees; they are usually white or bright scarlet and decorated with some geometrical pattern made by sewing strips and small pieces of coloured skin to the front and top of the boots. The native boots, known as kammiker, are double; into the outer covering of seal-skin fits an inner boot of dog-skin with the hair next the leg; some dried grass is placed between the two soles. The outer sole, made of the skin of the Greenland seal, is turned up all round the edge and very skilfully stitched to the upper part of the boot, made of the skin of another kind of seal (*Phoca hispida*). The skin of the sole is first chewed by the women to soften it before being stitched with sinews of whale or reindeer. The kammiker are very comfortable and warm; their soft soles, which are kept in good condition by being frequently drawn backwards and forwards over a metal edge, are admirably adapted for walking over smooth, slippery rocks, and they are water-tight. Above the trousers the women wear a broad belt and a blouse, both made of some brightly coloured material, and on special occasions an elaborate home-made collar of open beadwork over the shoulders. The once prevalent custom among the women of gathering up the hair into a short column on the top of the head is dying out, but it is still seen, especially in the smaller settlements. A red band round the top-knot is the badge of a maid; blue denotes a married woman; black a widow, and green an unmarried woman who is a mother."

UNDERGROUND LONDON

In his book entitled *Man as a Geological Agent* (H. F. & G. Witherby, 20s.), Dr. R. L. Sherlock has developed an unusual field of knowledge by showing how extensively man has altered the surface of the earth. Amongst a vast amount of other important information, he gives the following details concerning the enormous excavations beneath London: "We find the excavation," he says, "within the City and County of London to be as follows:

	Cubic yds.
From wells and borings	70,500
The main intercepting and storm-water sewers	14,000,000
The tube railways (to 1914)	7,143,000
The Inner Circle	4,119,000
The Great Central Railway, Marylebone to Canfield Gardens, surplus excavation	540,000
The remaining railways; cuttings and tunnels	20,350,000
The Greenwich Footway—the Rotherhithe and Blackwall Tunnels	513,967
The Victoria, Albert and Chelsea Embankments	336,000
Docks, drains, foundations of buildings, etc., at least	3,000,000
TOTAL	50,081,467
Say	50,000,000

"Spread uniformly over the 116·9 square miles of the Administrative County of London, the average excavation would amount to about $3\frac{3}{4}$ in. The excavations under London do not produce subsidence, as is the case with mining operations, because the ground is carefully supported by engineering structures. The underground excavations, therefore, are spaces filled with air or water. There may, however, be a small amount of subsidence due to the slipping of gravelly foundations under weighty buildings, as is said to be the case at St. Paul's, and also to the solution of chalk by the water pumped from borings."

THEATRICALS IN TIBET

An interesting account of a typical feast conducted by Tibetans in celebration of the seventh day of the moon is given by Mr. Eric Teichman in his recently published book, *Travels of a Consular Officer in Eastern Tibet* (Cambridge University Press, 25s.). The author found himself stationed in Western China when hostilities broke out between Chinese and Tibetans on the border in 1918, and acted as mediator between the local frontier leaders on both sides. In the course of his activities he reached and stayed at Chamdo, in Eastern Tibet, in July and August. The festival started on August 8, and opened with a theatrical performance:

"On the first day a theatrical performance was held, starting at eight in the morning and finishing at dusk. The stage was an open piece of ground in front of the Kalon Lama's house and the players were Tibetan soldiers. We watched the play from the windows of the Kalon Lama's apartment, conversing and consuming light refreshments between the morning and evening banquets. The players refreshed themselves at frequent intervals with copious draughts of *chang* provided by the Kalon's stewards; so that their acting became more and more energetic as the day wore on.

"Tibetan plays are either religious or lay. Of the former, which are performed by lamas and are often called Devil Dances by foreigners, the commonest is the 'Dance of the Black Hat,' illustrating the killing of the notorious persecutor of Buddhism, King Lang-

darma, by the monk Palgidarje, in the ninth century. The present play, being performed by soldiers, was a lay one; it was a sort of musical comedy, and was accompanied by singing and dancing and clown-like antics. The plot centred round the love affairs of a Tibetan king, named Kalawonga, who got into difficulties over his two wives. The principal comedians represented semi-savage Tibetans from the extreme west of Tibet and swashbuckling braves from Kam; these being the characters assigned to the people of Western and Eastern Tibet respectively by the more refined and civilised inhabitants of the central Brahmaputra basin. The piece is one of the best known of Tibetan plays, and the acting was loudly applauded by the audience, who, apart from ourselves, consisted of most of the population of Chamdo, as well as many Tibetans from the neighbourhood.

"Towards the end the house was brought down by the appearance of five actors representing the 'Tribute Nations' (i.e. tributary to the Manchu Emperor), dressed respectively as a Chinese, a Tibetan, a Mahomedan, a Mongol, and a Bhutanese. The actor dressed as a Chinese elicited further roars of applause by saluting the Kalon Lama in the old-fashioned Peking way by bending down and touching his boot. The grand finale, as darkness was falling, consisted in presentations of parcels of tea, sacks of barley-meal and packets of rupees to the actors. The rupees were thrown down by the members of our party from the windows of the Kalon's house, and the players, festooned with complimentary *katas*, then came and expressed their thanks. The scene finally closed with a bonfire of green juniper bushes and clouds of *tsamba* cast into the air; everything being done, said the Kalon, strictly according to *Lhasa lugso* (Lhasa fashion). Everyone seemed very happy, and not a few were considerably inebriated by the end of the day. A popular beanfeast is indeed much the same thing all the world over, whether it be August Bank Holiday on Hampstead Heath or Chislehurst Common, or the seventh moon festival at Chamdo."

WIRELESS WAVES AND THE ATLANTIC

"While communication across the Atlantic has been maintained regularly now for more than twenty years, it must not be imagined that there are no difficulties and that all the problems have been solved. In spite of a high degree of perfection in the instruments for producing electrical waves and in those used to detect them, the wave meets with many adventures on its way, and there is some uncertainty as to how it really gets there. One of the problems which, while it had been surmounted practically, evaded theoretical explanation, is the particular path pursued by the wave between the stations. When Marconi first made the attempt to put England and the American continent into communication, there were no scientific facts which pointed to success, but there were some which indicated the impossibility of surmounting the great aqueous hump of the Atlantic, 125 miles high, which lies between. An electric wave is in effect a very long light wave travelling with the same velocity—186,000 miles a second—and possessing many other similar characteristics. Now light waves show a rooted objection to turning a corner. Save for a slight bending round the edges of objects, they pursue a straight path from origin to destination. If an electrical wave were endowed with equal rectitude, and were launched on its way to Canada from Poldhu, it would arrive there something like a thousand miles above the land. Signals hovering in the heavens above and having no tangible connection with the earth below would be rather useless; from that height they could not even be collected by a kite. Fortunately, however, the waves come to earth themselves, and there is some evidence to show that they travel all the way through the air. Perhaps a more striking illustration of what the curvature of the earth involves is to be found in the fact that, when receiving signals at Buenos Ayres from Clifden, a distance of 6,700 English miles, Marconi was detecting waves which had been deflected from their original direction by 97°!"—Edward Cressy in his *Discoveries and Inventions of the Twentieth Century*. 2nd Edition. (Routledge & Sons, Ltd., 12*s*. 6*d*.)

THE FUTURE OF MAN

"Perhaps in future ages the progressive evolution of man will continue, somewhere and somehow. If higher species of man evolve in the future, it is not unlikely that this will occur, as in the past, in connection with great secular changes, over which man has no control, such as the rising and sinking of continents, the formation of deserts or mountains or oceans, or changes in climate comparable to the glacial and interglacial epochs, during which human evolution made such wonderful progress.

"In the present conditions and tendencies of the human race, in the contest between progressive and retrogressive forces, we see much cause for anxious concern, but thinking on the distant past and the boundless future creates a feeling of detachment and of philosophic calm like that of the dwellers on Olympus. We cannot see clearly the next scene, we can scarcely imagine the next act, and the end of the great Drama of Evolution, if there is to be an end, is a matter of faith alone."—Professor Edwin Grant Conklin in *The Trend of Evolution*, one of the essays published in *The Evolution of Man*. (Yale University Press, and Humphrey Milford, Oxford University Press, 15*s*.)

Some Examples of Collective Hysteria

By E. N. Fallaize, B.A.

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An interesting case of "mass hysteria" in Vienna was reported in *The Times* of November 16 last. "Mass hysteria" is a term applied to cases in which, when a group of individuals is collected together, as, for instance, in a factory, the nervous collapse of one is immediately followed by that of others as though subject to contagion. In the instance in question, an ex-soldier and his wife, after waiting in a queue for some hours at the offices of the Municipal Lodgings' Board, were informed that no accommodation could be found for them. The woman broke down and went into an hysterical fit. Her husband followed suit, and six of their neighbours in the queue were similarly affected. The fits were so violent that ambulances had to be brought to take the sufferers to hospital. The theory has been advanced by medical men that this attack of hysteria was due to malnutrition.

On the other hand, though malnutrition is probably a contributory cause, the Vienna case may serve to recall the fact that a peculiar form of hysteria is not uncommon in Eastern Europe. In the Balkans, women are said to have been driven mad under the stress of the Turkish régime and to have gone about "barking like dogs." Miss Durham,[1] who had the opportunity of examining one case, said this "madness" was really a peculiar type of hysteria, the so-called "barking" being a form of hiccough. A local cure is to bid the patient attend church on a special saint's day and refrain from making a noise during the service. Similar cases are said to be frequent in Russia.

The evidence would suggest that such a form of hysteria is one to which certain racial strains are peculiarly liable; but this aspect of the question needs further investigation. Hysterical and epileptic affections, as is well known, play an important part in the history of religion in connection with the phenomena of "possession" and the function of the oracle and the seer. The medicine man of primitive races is frequently of an abnormal type, and his reputation for magical powers, particularly when his office is hereditary, is connected with mental and physical peculiarities which are probably congenital. In these abnormalities, however, he does not appear to differ markedly from the usual type of hysterical or epileptic subject.

Mrs. McGovern, in her recently published book, *Among the Head-hunters of Formosa*,[2] says that the priestesses of the Taiyal, in order to drive off the rain-devil, engage in a frenzied dance, gesticulating with knives, while the people stand around and howl and wail. The priestesses "foam at the mouth in their excitement, their eyes look as if they would start from their heads," and at last they fall exhausted in a swoon. The author suggests that this is a case of "arctic madness" (presumably meaning arctic hysteria), and the "almost hypnotic imitation" characteristic of all Mongol and Malay races and common among sub-arctic peoples. It is perfectly true that the "Malay"—not confining this term exclusively to the inhabitants of the Malay Peninsula, but extending it to cover the related peoples of the Indonesian area —appears to possess a peculiarly highly strung and ill-balanced nervous organisation, as is shown in the practice of "running amok" when the subject of some painful emotion endeavours to find relief in killing as many people as possible until himself killed. But it is probably incorrect to describe this as a form of "arctic hysteria"; nor does the ceremonial of the rain-devil exorcism in Formosa, as described by Mrs. McGovern, suggest, except superficially, that it is a case of this abnormality. The mental and physical condition of the priestess resembles rather that of those who take part in the ceremonial dances of the Veddas of Ceylon. There the shaman, or medicine man, attains a state of automatism in which he goes through a pantomimic dance leading up to a decisive action and then collapses. The bystanders also sometimes take part in the dances. Professor Seligman,[3] who has recorded his observation of these dances, says that the Veddas show no special hysterical or neurotic tendency.

Arctic hysteria, in its typical form sometimes associated with "mass hysteria," occurs especially among the sub-arctic tribes of Siberia. It is significant in connection with the possibility of its association with certain racial types, that the peculiar form of hysteria of Eastern Europe shows some points of strong resemblance to it. Among the Siberian tribes the shaman is a person of the greatest importance, especially in averting or driving away the spirits which cause sickness. As an instance of the procedure followed we may cite the case of the Jakut shaman.[4] He performs the ceremony of exorcising the spirits

[1] M. Edith Durham, *The Burden of the Balkans* (London, 1905), ch. vi. (Nelson's Reprint, N.D., pp. 132–3.)

[2] Published by T. Fisher Unwin, Ltd., 15s.

[3] C. G. and B. Z. Seligman, *The Veddas* (Cambridge, 1911), pp. 133–5, and footnote, p. 135.

[4] M. A. Czaplicka, *Aboriginal Siberia* (Oxford, 1914), pp. 234 fol. For evidence relating to the character and methods of the shaman among other Siberian peoples, see pp. 166 fol. of this work.

which cause sickness or other evils at dusk in a hut lighted by a fire only. After a violent attack of nervous hiccoughs, which makes his whole body shake, the shaman falls into a species of coma while gazing into the fire. He then starts up and performs a violent dance, leaping in the air and beating his drum under the influence of the spirits. The spirits may take possession of him with such violence that he falls flat on the ground. The conditions of life among these tribes are such as to produce a peculiarly susceptible mentality among all the people, but the shamans, who may be women as well as men, in particular exhibit markedly abnormal physical and mental characters. Congenital defects, such as an epileptic tendency or a peculiarly neurotic temperament, are fostered and aggravated by the prolonged course of training, lasting over a number of years and involving prolonged periods of fasting and solitary isolation to which every aspirant to the shaman's profession must submit. In these cases several factors are clearly involved—an abnormal individuality, malnutrition, environment, and possibly a racial peculiarity. The subject is of the greatest interest to anthropologists, and requires further careful investigation by competent observers.

Belief in After Life Amongst the Greeks and Romans—II

By W. R. Halliday, B.A., B.Litt.

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(*Continued from the January No., p.* 11)

THE most notable revolution which took place in Greek religion in the period following the composition of the Homeric poems was the introduction of the worship of Dionysus, the god of wine. In spite of local opposition, which has left its traces in religions legends, the cult was rapidly victorious, spread into every part of the Greek world, and even wrested from that of Apollo a share in the control of Delphi, the religious centre of the Greek world. It may well be that its progress was facilitated by the survival in some parts of Greece of vestiges of a fertility religion of similar general characteristics, which had flourished in the Bronze Age.

The Dionysiac Cult and the Idea of Elysium

The home of this conquering divinity was Thrace, where, as Herodotus tells us, the natives regarded this life as an unpleasant interlude in an immortal existence, heralded a birth with lamentation, and celebrated death with congratulatory festivities. Immortality at any rate was a fundamental assumption of the Dionysiac cult. Its members, intoxicated by wine and the dance, worked themselves into a frenzy in which live animals representing the god himself were torn in pieces and sacramentally devoured. Temporarily the ecstatic worshipper was identified with the god, and in a mystical frenzy realised partially and imperfectly the complete identification with the divine which might be his after death.

Now an important feature of this cult was its universality, for its clientele was not restricted to the members of any particular tribe, state, or sex. It was, therefore, a force working in the direction of universalism across the corporate exclusiveness and particularism of the city-state-religion. Universal, too, was the appeal of the Mysteries, and as early as the seventh century B.C. the Homeric Hymn to Demeter welcomes candidates for initiation into her Mysteries at Eleusis from any part of Greece. Alike in the mystery cults and in the Dionysiac sacrament the purpose of the ritual acts was directed towards a future life; the initiated was thought to pass at death to the pleasures of Elysium, while those who had not been initiated wallowed in bottomless slime. In its more popular form any religion which lays stress upon posthumous reward and punishment is liable to present unworthy features, and Plato pours his scorn upon the vulgar prophets of Orphism with their quack ritual prescriptions for attaining eternal happiness. But, though liable to abuse, such doctrines are capable of great ethical development as ritual qualification comes to be interpreted in terms of spiritual preparation. In fact, from Pindar onwards all the great religious thinkers of Greece, including Plato himself, are strongly influenced by the idea, which they owed in great measure to the Orphics, that this life is a preparation for immortality.

The Orphic Doctrine of Individual Survival after Death

The Orphic societies, to which we have thus made allusion, were the product of the Dionysiac movement, and took their name from the musician-prophet Orpheus, a figure belonging to Dionysiac legend. They were private mystical religious associations, membership of which was not restricted by any political grouping. Cardinal to their doctrine was the reality of the soul as opposed to the mortal and corruptible body, and their favourite catchword was *sôma sêma*, i.e. "body is tomb" (of the soul). Their ritual aimed at supplying individuals with the means

of attaining bliss after death through purification. They preached, in fact, a gospel of "salvation" and were the first proselytisers in the Greek world.

Orphic doctrines, with their insistence upon the reality of individual survival after death, not only influenced the wise, but also coloured the popular view. A minor but conclusive proof is supplied by popular vocabulary. In the fifth century B.C., as in modern Greece, the polite equivalent for "the late lamented" is "the blessed one," and "Go to Blessedness" is a form of objurgation to be found in the comedies of Aristophanes. Perhaps connected with Orphic theories of purification is the Platonic account (early in the fourth century B.C.) of the apparition of ghosts among tombs. In the *Phaedo* Plato explains that death is a liberation of the soul from the body, but that earthy natures are not easily and immediately purified sufficiently to obtain complete release. Its impurities in such cases weigh down the soul to earth and also cause it to be visible.[1]

Classical Ghosts

In drafting his legislation in the *Laws* Plato takes into account another popular belief, that the ghosts of those who had suffered a violent death continued to walk and were dangerous and vengeful. This belief probably has its roots in the primitive conviction that unexpiated murder, or the failure to carry out funeral ceremonies, brought spiritual danger to the community of which the dead man had been a member. It is doubtful whether this danger was originally personified as the ghost of the dead man. I am inclined to think not, and I know of no satisfactory evidence for the existence of the vengeful ghost in Homer.[2] But certainly before the time of Æschylus it was currently believed that the ghost of a murdered man demanded vengeance, and that until it was satisfied it was likely to attack with peculiar violence those near relations upon whom fell primarily the duty of seeing that vengeance was exacted. An extension of this line of thought leads to the belief that the ghost of a man secretly done to death is likely to haunt the place of the crime. This forms the motive of the most common and least interesting type of ghost story, an example of which is to be found in the letters of the Younger Pliny (about the end of the first century A.D.). The ghost of an old man with clanking chains rendered a house in Athens uninhabitable until the philosopher Athenagoras undertook a piece of psychical research. The ghost duly appeared, the philosopher followed its beckoning, and marked the place in the courtyard where it suddenly vanished. Digging operations next day brought to light a skeleton bound with chains; this was given proper burial and the ghost walked no more.

A curious vengeful ghost story is mentioned by several classical authors in connection with a celebrated Italian boxer Euthymus, who won his first victory at the Olympic Games in 484 B.C. In the course of his wanderings (seven centuries earlier, according to the traditional dating for the fall of Troy) Odysseus had put in at Temesa, where a tipsy sailor ravished a maiden, and was consequently stoned by the natives. The ghost of the sailor then began to kill the people of Temesa, until an oracle advised them to appease him by building him a shrine and offering him every year a most beautiful maiden to wife. On his way home from the Olympic Games Euthymus arrived at Temesa when one of these ceremonies was about to take place, fell in love with the girl, fought the ghost for her, and drove it into the sea. Euthymus himself, like many athletes, was worshipped as a hero after his death. Pausanias (in the second century A.D.) tells us that he had seen a copy of an old painting of the story. "The ghost was of a horrid black colour, and his whole appearance was most dreadful and he wore a wolfskin." Classical ghosts, indeed, were usually black, not white. Thus the boys who unsuccessfully tried to play a practical joke upon the sceptic Democritus dressed themselves in black with death's-head masks, and the ghost-dances of the Emperor Domitian (A.D. 81–96) were performed by boys with bodies painted black.

An allusion in Aristophanes shows that in the fifth century B.C. the possibility of meeting a ghost was regarded with terror; and the superstition that it was well to keep silence when passing a tomb for fear of attracting the hostile attention of the spirit of the dead man is first mentioned by Myrtilus, a comic poet of the generation before Aristophanes, but it is repeated by Menander in the fourth century B.C. and by Strabo in the reign of Augustus (31 B.C.–A.D. 14).

That popular opinion as to the location of the spirit after death showed inconsistency is hardly matter for surprise. The ghost, as we have seen, is sometimes thought to be resident at the tomb, but it was also thought that it went at death to the realm

[1] The English reader may care to be reminded of Milton's splendid version of this belief (in his *Comus*, l. 470), which ends with the lines:

"Such are those thick and gloomy shadows damp,
Oft seen in charnel vaults and sepulchres,
Lingering and sitting by a new made grave
As loth to leave the body that it loved."

—ED.]

[2] The threats of Hector (*Iliad*, xxii. 358) and Elpenor (*Odyssey*, xi. 73) are not of haunting by vengeful ghosts, but of the anger of the gods. Some scholars have held that the Erinyes, the Furies, were originally vengeful ghosts. Others more probably regard them as personifications of the power of the curse.

of the dead, which was located beneath the terrestrial world. Certain apparently bottomless chasms, a natural phenomenon not infrequent in a volcanic limestone country, were thought to be gateways of this underworld. At several of such places oracles of the dead were established. The most famous was that of the river Acheron in Thesprotis; others are mentioned at Tænarum in Greece, Heraclea in Asia Minor, and Avernus in Italy. The inquirer, like Odysseus, journeyed to the gate of the next world: here individual ghosts were evoked for his benefit, and, unlike the Homeric ghosts of ordinary mortals, they possessed supernatural knowledge. The Thesprotian oracle is mentioned by Herodotus in a story about Periander, the great tyrant of Corinth in the seventh century B.C. Periander sent to ask the spirit of his wife Melissa about the whereabouts of some property which had been entrusted to his care, but had been mislaid. The spirit of Melissa appeared, but refused to give her answer until she had been provided with suitable apparel, explaining that none had been burned with her corpse and that she was consequently cold in the next world. As a guarantee of authenticity she sent a riddling message about a matter known only to herself and Periander. Upon receipt of the reply Periander stripped the ladies of Corinth of their finery, dug a trench, a regular feature of sacrifice to the dead, and burned the clothes in it. Melissa then gave a second embassy the required information. Plutarch tells the story of a wealthy Italian named Elysius, whose son and heir had died suddenly. Elysius suspected that he had been poisoned, and repaired to the oracle of the dead to discover the truth. The ghost of his father appeared to him with the "genius" or spiritual double of his son. The latter handed him a book in which were verses explaining that the death was due to the wise dispensation of Fate. Pausanias, the victor of Platæa in 479 B.C., afterwards in Byzantium murdered Cleonice, a free-born maiden who had been the victim of his tyrannical lust. The ghost of the murdered girl haunted him until he visited the oracle of the dead at Heraclea and interviewed her spirit. The same Pausanias afterwards haunted the temple in which the Spartans had sacrilegiously done him to death, and it became necessary to send for professional exorcisers to lay the ghost.

Oracles of the Dead

The consultation of these oracles of the dead was the most reputable form of communication with the dead which throughout antiquity fell in the domain of magic and superstition rather than that of religion. Professional magicians called *Psychagogoi*, who claimed the power of evoking or laying ghosts, were common already in the fifth century B.C. They gave their name to one of the lost plays of Æschylus, and the plot of the *Persians* by the same dramatist turns upon the evocation from his tomb of the spirit of Darius, the Persian king. Like other practitioners of magic, these *Psychagogoi* were usually drawn from foreign and mysterious races—Egyptians, Etruscans, Thessalians, or Persian Magi. It was the latter whom the matricide emperor Nero employed to evoke and appease the ghost of his mother Agrippina. Long, unintelligible incantations in a barbarian tongue were characteristic of their procedure. They often claimed the power of summoning ghosts not only from a tomb, but direct from the nether world. Sometimes a suitable spot had to be found for this operation by observing the behaviour of the black sheep employed in the preliminary sacrifice, but at least in the later classical period magicians of the highest pretensions, like Apollonius of Tyana, claimed the power to raise the dead by spells without any limitation of place or necessity of sacrifice.

The "Medium" of Antiquity

The nearest analogy in antiquity to the modern "medium" is perhaps presented by a somewhat despised type of diviner who was supposed to be the instrument through which a familiar spirit or spirits communicated. They uttered their prophecies in tones unlike their natural voice, and were often called ventriloquists (ἐγγαστρίμυθοι), though they had several other names, such as *Pythones* or Sons of Eurycles, after a famous traditional member of the profession. They are referred to by Aristophanes in the fifth century B.C.; St. Paul exorcised a divining spirit of this kind from a female practitioner at Philippi; at the close of paganism the Christian Father Clement denounces them. The Septuagint uses the word ἐγγαστρίμυθος to express a Hebrew phrase, which means "diviner by spirits of the dead." I do not suppose that popular doctrine was rigidly exact, and I suspect that the familiar spirits of the ventriloquists were often, but not exclusively, defined as spirits of the dead.

Necromancy and Black Magic

The uses of the spirits of the dead in magic were naturally many and various, particularly at the close of the second century A.D., when necromancy and witchcraft became both prevalent and persecuted. The practice of attaching spells to the walls of tombs, which, beginning in the fourth century B.C., became common throughout later classical antiquity, I have noticed in a previous paper.[1] In some of these spells the spirit of the dead man to whom the tomb belongs

[1] *Horse Racing and Magic under the Roman Empire*, DISCOVERY, vol iii, No. 28, p. 99.

is specifically called upon to carry out its provisions. The practice of employing a corpse as a sort of medium into which to summon a spirit is common in the magical papyri; and earlier, in the first century after Christ, the poet Lucan describes how a witch conjured the spirit back into the body of one recently slain.

This probably belongs to the barbarities of exotic magic which became more repulsive and more elaborate as classical civilisation became overripe. The horror of human sacrifice has always made it an appropriate feature of Black Magic. Its practice for divinatory purposes is laid to the charge of Vatinius by Cicero. Some instances of such divinatory human sacrifices appear to be based upon a belief, which is very common in many lands, that at the actual moment of death the spirit is simultaneously in connection with both worlds. Its connection with the next world gives it supernatural intelligence; its connection with this world enables it to communicate it. The Arabs of the Middle Ages, who employed criminals for this purpose, often deliberately protracted the sufferings of the victims in order to prolong the opportunities of this intermediate state.[1] This theory too was known in later classical antiquity, and calumny asserted that Antinous, the beautiful favourite of the Emperor Hadrian, was a voluntary victim to a magical sacrifice of this character.

Generally speaking, as our brief survey will have suggested, although from a comparatively early date in classical antiquity the belief in personal survival was common, and the possibility of communication with spirits of the dead was not denied, its practice was attempted not from scientific motives, nor in order to regain touch with the beloved, but in order to obtain knowledge of the future; with the exception of the ritual of hero-worship, which is not really analogous to modern spiritualism, it was not highly regarded and belonged rather to magic than to religion.

(*Concluded*)

BIBLIOGRAPHICAL NOTE

The most important books dealing with these matters are Rohde, *Psyche: Seelenkult und Unsterblichkeitsglaube der Griechen*; and Farnell, *Greek Hero Cults and Ideas of Immortality*. Some references with regard to necromancy are collected in Halliday, *Greek Divination*. An entertaining, if slight, little book is Collison Morley, *Greek and Roman Ghost Stories* (Blackwell, 1912). Readers with a knowledge of Greek may be referred to Headlam, "Ghost-raising, Magic and the Underworld," *Classical Review*, xvi. The best short history of Greek religion is Farnell, *Outline-History of Greek Religion*; the Orphic tablets which were found in Southern Italy are discussed in Miss Harrison's *Prolegomena to the Study of Greek Religion*. The influence of Orphism upon Greek thinkers may be studied in Adam, *The Religious Teachers of Greece*.

[1] See the passage in Ibn Khaldun referred to by Doutté, *Magie et Religion dans l'Afrique du Nord*, p. 401.

Reviews of Books

MATHEMATICS AND THE ATOM

(*a*) *Dimensional Analysis*. By P. W. BRIDGMAN. (London: H. Milford; New Haven: Yale University Press, 25*s*.)

(*b*) *The Theory of Spectra and Atomic Constitution*. By NIELS BOHR. (Cambridge University Press, 7*s*. 6*d*.)

(*c*) *A Treatise on the Theory of Bessel Functions*. By G. N. WATSON, Sc.D., F.R.S. (Cambridge University Press, 70*s*.)

(*d*) *The Quantum Theory*. By FRITZ REICHE. Translated by H. S. Hatfield and H. L. Brose. (Methuen & Co., 6*s*.)

(*a*) The use of the methods of dimensional analysis both in technical physics and in theoretical investigations is growing, and, indeed, it is desirable at the present time that every physicist should have this method of analysis at his command. But, perhaps because the subject appears so simple that a formal presentation of it is unnecessary, no systematic exposition of the principles of the methods has preceded this one by the professor of theoretical physics at Harvard. A subject, however, must have a book about it sooner or later, and it is excellent that the first one should be written by an acknowledged expert on it. The book is, of course, chiefly for those who have already some acquaintance with the general method. It contains a systematic exposition of the principles of the subject, and full illustration of applications chosen to emphasise the points most commonly misunderstood, like the nature of a dimensional formula, the proper number of fundamental units, and the nature of dimensional constants. References to previous work are given in each chapter, and at the end of the book are many problems for a reader to solve. But why is the price of a book of a hundred and ten pages so high? The book should find acceptance by a wider circle of readers than the price fixed for it indicates, for the subject, besides being interesting, is one easily followed by many who are neither widely read physicists nor profound mathematicians. It is the first book on the subject, on which its author is a well-known authority, and, let it be said, his exposition is very clear. The book is based on a series of lectures to a Graduate Conference at Harvard two years ago.

(*b*) All students of chemistry and physics will be grateful to Prof. Bohr, of Copenhagen, for putting his highly original and exceedingly profound theoretical work on atomic structure in a form which they have at least a chance of understanding. The book is a translation of three essays written at different times in the past nine years. In the third the author describes the remarkably detailed view of the structure of the atom to which he has been led, a view which attempts to explain the relations summed up in the Periodic Table and to give a natural reason for the occurrence of the rare earths.

We cannot say that this book is easy reading, but that is not the author's fault. The detailed structure of the atom of reality cannot apparently be satisfactorily explained by simple images nor described in little words of one syllable. Rutherford's atom, Planck's quantum theory, Einstein's relativity principle, have all been blended with Dr. Bohr's own ideas and postulates to set forth the picture of the atom. It can never be simple to our humble intelligence, but, though complex, it "rings true" and explains the properties of the atom known from experiments as no other picture yet conceived can.

(*c*) This is the most complete account of Bessel functions in English, and, written as it has been by one who has done distinguished original work in it, it should be the standard work for many years. It is primarily for the "pure" mathematician, but it contains also a collection of results which will be of increasing value to the number of mathematicians and physicists who encounter Bessel functions in the course of their researches. It is not a book that could be easily filmed!

(*d*) Prof. Fritz Reiche's book on the quantum theory is an excellent compilation for the student. It appears to be a translation of one of the German Vieweg series, most of which are good. This one certainly is. Prof. Reiche begins at the beginning, which is Planck's first work in 1900, and brings the record down to 1920. In 135 pages he succeeds in giving the gist of the main body of work. Full references to, and notes on, original papers are given; indeed these occupy a quarter of the whole book, and their inclusion enhances the value of the record. The student who is interested in and can understand this subject is lucky to have such a compilation as this at so low a price. The translation is good. It might have been better if some of Dr. Reiche's more enthusiastic expressions had been toned down in translation. And we should have preferred the proper names in the book not to be printed in italics. They give us the idea that the author is whispering something we must keep secret. A. S. R.

Symbiosis v. *Cancer*. By H. Reinheimer. (Headley Brothers, 5*s*.)

We have long been accustomed to the voice of the critic who tells us that all morality is based on expediency, who looks upon systems of ethics as variations on the theme "Honesty is the best policy." To such a critic, the argument that a moral law is obviously of service to the individual or to the community satisfactorily robs it of any spiritual quality. It is at least refreshing to find this author ascribing, by a reverse process of argument, a spiritual value to expediency. "Nature, red in tooth and claw," was the poet's comment on the theory of evolution, which laid such emphasis on the factor of combat and competition in moulding the features of living things. Mr. Reinheimer looks the other way—he sees the genius of mutual accommodation as the great creative power. This emphasis is certainly a salutary influence on a traditional and one-sided view of evolutionary factors. Many examples of mutual help between plants and animals—such as the association between water-plants and developing frog's spawn, and their exchange of gases, are quoted, and strikingly bear out the author's bias in favour of co-operation.

Mr. Reinheimer stresses, as has been said, the almost mystical value of systems of mutual help among living creatures. It would be easy to be witty at the expense of the virtuous lichen—a harmony between two forms of plant life which shows symbiosis to perfection—and to recall W. S. Gilbert's "Not too French French bean." The question, however, is perhaps not quite so simply to be disposed of, and it is for philosophers to say where virtue and moral values begin and end.

The title of the book is in some respects misleading. It is not a contribution to cancer research, but a reply to critics and a fresh gospel of symbiosis, or "living together." The most obvious thing about a malignant growth is that it consists of cells at enmity with the body politic. An example is quoted, where cells from an apparently normal portion of a malignant growth grew, in a test-tube, to malignant cells, when away, as the author would have it, from the restraining influence of the rest of the body. No pathologist would venture to assert that the cells in question were ever any than true cancer cells; in fact, there is often nothing but their irresponsible behaviour to distinguish them from normality. The body's restraining influence, therefore, is not in question.

But the cancer problem occupies only a small portion of the book; where it is discussed the same anthropomorphic attitude forces the writer to speak of "nobler parts of a cell," and to introduce such phrases as "licentiousness must be penalised." After all, the ethics of the case are clear. Cancer cells are undoubtedly felons. Our task is not to pass judgment, but to seek cause and remedy, whereof we read little in this small book, refreshingly out of the groove though it be. R. J. V. P.

Outwitting Our Nerves. By Josephine A. Jackson, M.D., and Helen M. Salisbury. (Kegan Paul 7*s*. 6*d*.)

A breezy and encouraging discourse on nerves (addressed to those who suffer from them) by authors of vigorous personality. The book contains a superficial but, as far as it goes, accurate account of the Freudian principles without excluding the work of the other schools, and if it serves no other purpose, at least it may help the neurotic to realise that his condition is not incurable. The authors' emphatic and colloquial style may prove less acceptable to the English than to the American reader, but the book contains much sound sense and useful advice.

Juvenile Delinquency. By Henry Goddard. (Kegan Paul, 3*s*. 6*d*.)

A short account of the work of the Ohio Bureau of Juvenile Research, too slight to have much scientific value or more than local interest.

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY

The Evolution of Man. Sigma Eleven Lectures delivered at Yale University 1921–22. Lull, Ferris, Parker, Angell, Keller, Conklin. Edited by G. A. BAITSELL. (Humphrey Milford, Oxford University Press, 15*s.* net.)

The Bronze Age and the Celtic World. By HAROLD PEAKE, F.S.A. (Benn Brothers, Ltd., 42*s.*)

MISCELLANEOUS

A Descriptive Catalogue of Land Charters and Other Documents, forming the Brooke Taylor Collection, relating to the outlying districts of Sheffield. Compiled by T. WALTER HALL, M.A., etc. (Sheffield: J. W. Northend, Ltd.)

Anglo-Saxon Monumental Sculpture in the Cambridge District. By CYRIL FOX. (From the Cambridge Antiquarian Society's Communications, vol. xxiii.)

Travels of a Consular Officer in Eastern Tibet, together with a History of the Relations between China, Tibet, and India. By ERIC TEICHMAN. (Cambridge University Press, 25*s.* net.)

A Hind in Richmond Park. By W. H. HUDSON. (J. M. Dent & Sons, 16*s.*)

Calculus and Probability for Actuarial Students. By ALFRED HENRY, F.I.A. (Charles & Edwin Layton, for the Institute of Actuaries.)

Life Contingencies. By E. F. SPURGEON, F.I.A. (Charles & Edwin Layton, for the Institute of Actuaries.)

Greek Art and Architecture; their Legacy to Us. By PERCY GARDNER, F.B.A., and SIR REGINALD BLOMFIELD, F.S.A., R.A. (Oxford University Press, 2*s.* 6*d.*)

Orographical, Regional, Economic Atlas: Part IV, Africa. Editor, THOMAS FRANKLIN. (W. & A. K. Johnston, Ltd., Edinburgh, 1*s.* 6*d.*)

PHILOSOPHY AND PSYCHOLOGY

Group Psychology and the Analysis of the Ego. By SIGM. FREUD, M.D., LL.D. Authorised trans. by JAMES STRACHEY. (International Psycho-Analytical Press and George Allen & Unwin, Ltd., 7*s.* 6*d.*)

The Principles of Logic. 2nd Edition, revised, with commentary and terminal essays. 2 vols. By F. H. BRADLEY, Fellow of Merton College, Oxford. (Oxford University Press, 36*s.* net.)

The Psychology of Self-Consciousness. By JULIA TURNER, B.A. (Kegan Paul, Trench, Trübner & Co., Ltd., 6*s.* 6*d.*)

The Omnipotent Self. By PAUL BOUSFIELD, M.R.C.S., L.R.C.P. (Kegan Paul, Trench, Trübner & Co., Ltd., 5*s.*)

SCIENCE

Le Volvox: Deuxième Mémoire. Par CHARLES JANET. (Les Presses Universitaires de France.)

Man as a Geological Agent. An Account of his Action on Inanimate Nature. By R. L. SHERLOCK, D.Sc., A.R.C.Sc., F.G.S., with an introduction by A. Smith Woodward, LL.D., F.R.S. (H. F. & G. Witherby. 20*s.*)

Discoveries and Inventions of the Twentieth Century. 2nd Edition. By EDWARD CRESSY. (G. Routledge & Sons, 12*s.* 6*d.*)

Symbiosis v. Cancer. By H. REINHEIMER, with a preface by Sir William Veno. (Headley Brothers, 5*s.*)

Mathematics and Physical Science in Classical Antiquity. Translated from the German of J. L. HEIBERG by D. C. MACGREGOR. (Chapters in the History of Science, Oxford University Press, 2*s.* 6*d.*)

A Guide to the Elephants (Recent and Fossil) exhibited in the Department of Geology and Palæontology in the British Museum (Natural History). 2nd Edition. (Sold at the British Museum (Nat. Hist.), and by B. Quaritch, Ltd., Dulan & Co., Ltd., and the Oxford University Press, 1*s.*)

The Racing Eight. Notes on its Design and Propulsion. By W. B. COVENTRY. (Heffer & Sons, Ltd., 3*s.* 6*d.*)

A book of about forty pages chiefly in praise of a noted Tyneside boat-builder and expert oarsman, Mat Taylor. Its object is to suggest that one way of increasing the speed of the racing eight is to take cognisance of this man's work.

Cements and Artificial Stone. By J. WATSON, M.A., F.G.S. (Heffer & Sons, Ltd., 6*s.*)

A descriptive catalogue of the specimens in the Sedgwick Museum, Cambridge, with notes relating to the history, geology, and chemistry of the materials they represent written for students of Economic Geology.

Machine Construction and Drawing. By FRANK CASTLE, M.I.M.E. (Macmillan & Co., Ltd., 7*s.* 6*d.*)

A textbook on the subject first published in 1905, reprinted several times subsequently, and now with additions.

The Andover District. An Account of Sheet 283 of the one-inch Ordnance Map. By O. G. S. CRAWFORD, B.A. (Oxford University Press, 7*s.* 6*d.*)

This volume of *Oxford Geographical Studies* is a detailed description, both from the physical and economic standpoint, of a part of the counties of Hampshire, Wiltshire, and Berkshire, in which Andover is the largest town. The author is well known for his contributions to what might be called the archæological and anthropological sides of geography, and this account of one of the parts of England best known to him is in his best manner. There is a good deal of original work in the book, especially in the appendices, which form half of it. Those on prehistoric sites and discoveries, on the grouping of parishes, on Anglo-Saxon bounds, and on the evolution of place-names will especially appeal to those who take an interest in these subjects. There are some interesting photographs and useful maps.

The Radio Amateur's Handbook. By A. FREDERICK COLLINS. (G. G. Harrap & Co., Ltd., 7*s.* 6*d.*)

The Evolution of Climate. By C. E. P. BROOKS, M.Sc., F.R.Met.Soc. (Benn Brothers, Ltd., 8*s.* 6*d.*)

Elementary Geology, with special reference to Canada. By A. P. Coleman, M.A., Ph.D., F.R.S., and W. A. Parks, B.A., Ph.D., F.R.S.C. (J. M. Dent & Sons, Ltd., 15*s*.)

Climatic Changes: their Nature and Causes. By Ellsworth Huntington and Stephen Sargent Visher. (London: Humphrey Milford; New Haven: Yale University Press, 17*s*. 6*d*.)

Correspondence

GREEK CHILDREN'S GAMES

To the Editor of Discovery

Sir,

May I add a couple of notes to Professor Halliday's paper on "Greek Children's Games"; and may I hope, by the way, that that paper is not Professor Halliday's last word on this pleasant theme, for he might easily go on telling us more such stories for a long time to come? So world-old are our children's games that it is no wonder they were played in the not remote antiquity of Greece and Rome; the fact is, I can scarce think of one of them which the Greek children did not know. They trundled their hoops, they whipped their tops, they rode a-cock-horse on daddy's walking-stick; they played with marbles, nuts, or cherry-stones (ὤμιλλα, τρόπα)—"papes" we used to call them (*Anglice* "pips") at my first of schools; they played chuck-farthing (ἀφετίνδα), ducks and drakes (ἐποστρακισμός), "stots" or "bouncers" (ἀποῤῥάξις, οὐράνια), "chuckies" (πεντάλιθα), cock-shies (ἐφεδρισμός), hide-and-seek (ἀποδιδρασκίνδα), hie-spy (κολλαβισμός), tug-of-war (διελκυστίνδο), king-of-the-castle (βασιλίνδα), and I know not how many more.

Professor Halliday tells us of blind-man's-buff, or that form of it known as the "Brazen Fly" (μυῖα χαλκῆ, μυιίνδα), and he asks whence comes the name. I think I know. The fly is the fierce and angry Gad-fly (*Tabanus*), whose incursion into a field sets the cattle wild with fear; and the one player is "the fly," and the rest are the cattle romping round. The yellow wasp-like colour of the fly explains the "brazen" epithet; but what has all this to do with blind-man's-buff—why is "the fly" blind-folded? Because it was an old belief that these flies, buzzing aimlessly around, *were* blind. Aristotle says that the μύωψ dies of dropsy in its eyes, and Pliny tells us so of *Tabanus*. Linnæus accepted the story, and described a common species as *Tabanus cæcutiens*. The Swedes call it "blind-knagg," the Italians "muia ceca": and if I am not dreaming (but here some better scholar may help or correct me), I think I have heard that "muia ceca" in Italian is still applied to the game, as well as to the fly.

A word more about what Professor Halliday calls "Torty Tortoise"—as Dr. Rouse also calls it in his delightful little book of Greek and Latin "Chanties." I have no doubt for my part (and Dr. Rouse accepts my suggestion) that we have here not only the old game, but the very selfsame tune, of "Jingaring" or "Here we go round the Mulberry Bush," with its many verbal variants.

The few scraps of the Greek version which remain need emendation, obviously enough; and we may emend, I maintain, provisionally at least, more boldly in such a case than we should dare do in an ordinary text. What poor fragments of the "Mulberry Bush" would remain two thousand years hence if we had only the dictionary-makers to hand them on! But children's memories are better than all the lexicographers. I would emend boldly; for my ear convinces me that the old tune is not to be mistaken in the few extant words.

A child sits or stands in the middle of the ring, and the others sing in chorus: "What are you doing within the ring, within the ring, within the ring, What are you doing within the ring, On a cold and frosty morning?" Or so, I think, they sang it in Greek—Τί ποιεῖς ἐν τῷ μέσῳ, ἐν τῷ μέσῳ, ἐν τῷ μέσῳ, Τί ποιεῖς ἐν τῷ μέσῳ, Χαῖρε (?) χέλι χελώνη. What χέλι χελώνη means I have no idea, nor do I think it worth while conjecturing. What can we make (save for a vague tradition) even of "Dickory, dickory, dock," or what of "Merry-me, merry-me Tanzy?" I half believe, or suspect, that χέλι χελώνη is but an untranslatable corruption of something far more ancient, more ancient perhaps than Athens; just as "Hey, diddle, diddle, the Cat and the Fiddle" is (we are told) a corruption of a very ancient and even hallowed Hebrew rhyme!

Then the child in the middle sings—"I spin my wool and I wind my thread, wind my thread, wind my thread": Ἔρια ἐκμαρύομαι, μαρύομαι, μαρύομαι, κτλ. Another child is pushed into the ring (I think), and the song goes on: "What is your child a-doing in there, doing in there, doing in there," Ὁ δ' ἔγγονός σου τί ποιεῖ, τί ποιεῖ, τί ποιεῖ. And so on, and so on, doubtless with variations *ad libitum*. Only the other day in a German town I came upon a troop of little girls singing the same song. The one in the middle had her little knuckles in her eyes, and as I passed the rest were singing, "Nun fängt sie an zu weinen, zu weinen, zu weinen"; I wish I had waited to hear more.

Not only do I seem to hear this old lilting tune in this particular Greek game, but I hear it also in several others. I think that in the mysterious wedding-chorus of ἔκκορι, κόρι κορώνη we have the last line of the same tune, the same refrain as in χέλι, χέλι χελώνη; and, with all respect to the commentators, I think the jingling words are beyond analysis and translation. We have the first part of the verse again in "Come out, dear Sun, come out in the sky, come out in the sky, come out in the sky": Ἔξεχ' ὦ φίλ' ἥλιε, φίλ' ἥλιε, φίλ' ἥλιε. Again we have it in: "Here I come with my limping Goat, my limping Goat, my limping Goat": χωγὸν τραγίσκον ἔξαγω, ἔξαγω, ἔξαγω. And the little maids in the festival procession sang it once more, "Here we go up to London-town, to London-town, to London-town": Ἴωμεν οὖν Ἀθήναζε, Ἀθήναζε, Ἀθήναζε.

In all of which several rhymes I am simply quoting Pollux and others—with a *very little* emendation of my own.

Yours, etc.

D'Arcy W. Thompson.

The University of St. Andrews.

December 20, 1922.

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Editorial Notes

THERE is a tale of three eminent botanists—a Frenchman, a German, and an Englishman—who were stranded on an ocean island where there were only fourteen varieties, all told, of green plants. Fortunately, one of these was new to science; unfortunately none of these scientists knew a word of any language save his own. Such a momentous discovery (made, as it happened, simultaneously by all three botanists, since the whole island was carpeted with the flower, a species of daisy) called for deep discussion. It is said that science found out a way, and in an intricate language evolved by stringing together the Latin names of well-known flowers, the international conference unanimously decided that the flower was a daisy, but rather less so than most daisies. The tale may be exaggerated; it must be admitted that the problem of verbs must have been acute. But it serves to point a moral—that in a world where the influences which separate nations are all too many, in science and in the pursuit of what we mean by that disgraced word "culture," there are influences which work powerfully in the direction of friendship and mutual esteem.

* * * * *

In this world of unattained ideals and fruitless labours, one individual has an easy road to eminence, and that individual is the pessimist—in spite of the fact that a German author, Max Nordau, whose death occurred this year, called Pessimism the most marvellous production of the human intellect in any age. We are almost always right in prophesying, for example, that bread will fall the buttered side underneath. When we point with pride to our new London omnibus, or our latest Latin dictionary, we are sure to be reminded by Dean Inge at home or Mr. Shafer in America that we still remain human, and that therefore our buses and dictionaries are not true "progress." And when the question of internationalism arises in a general conversation, we may be certain that the speaker whose voice will be most full of conviction will be the one who foretells imminent failure and oblivion to the League of Nations and all its works. To be sure, Life is an incurable disease—it always ends in death; the cave men were our superiors, let us admit, in teeth and possibly in stone-axe manufacture; we will grant readily that Plato was a greater philosopher and a more outspoken essayist than any to-day; and finally that there have been many wars and many treaties, and that a hundred dreams of world peace have ended in disappointment. Yet we believe that the world is not chasing a bubble in its search for knowledge and its development of the world's resources; we believe that in these very pursuits lies the hope of the great ideal of international friendship.

* * * * *

Let us face again the question which Adam, doubtless, pondered as he fell asleep on his first night in Eden—what is the real aim and object of human endeavour? Dr. Johnson said that it was happiness at home; later he apparently changed his mind and said that happiness was greatest when travelling in a stage coach from one place to another. We must reluctantly assume that Dr. Johnson did not know the answer to that age-old question. Dean Inge, judging from the prominence which Eugenics assume in his *Outspoken Essays*, believes that the object of the world of to-day is to breed with discretion the world of to-morrow, and his wholesale condemnation of a great proportion of the world of to-day would leave that section without any object in living. There are a large number of people who believe that the great object of existence should be the improvement of the lot of others, and a devotion to their interests. Carried to its logical

conclusion, this attitude towards life, admirable in itself, would lead to a state of affairs where we took in each other's washing and sacrificed ourselves to others who with equal obstinacy sacrificed themselves to us—a situation which presents some difficulties and discloses little definite advantage.

* * * * *

The goal of scientific and social endeavour would appear to be a state in which the control of natural sources of energy was such that we were all fed and clothed and housed with an absolute minimum of effort and a maximum of efficiency, and were thereby set free to spend all the years of our life in the sole pursuit of our individual ideals and hobby-horses—each of us a hundredfold millionaire with all that the universe could grant at our finger-tips. No one supposes that even such an extravagant to-morrow would involve "progress" in the human mind. But the answer to all who argue that material progress is of no value is that which Mrs. Boswell gave to Dr. Johnson when he said that wealth lets nothing in. She asked, "But what does it keep out?" It is believed that Dr. Johnson was at a loss to reply. Perhaps even Dean Inge would be.

* * * * *

We have wandered a little from our botanists on the daisy-carpeted island. But if we address ourselves to considering for a moment what the scientific ideal tends to "keep out," we find ourselves quickly in their company again. There is one sphere in which internationalism is already attained. Whether or not the economic conditions of nations are mutually related (and this is fairly certain), there is no doubt whatever that we share our diseases, and that what is a scientific truth in Berlin remains true in London and even to some extent in Paris. The world of science and learning is blessed with a serenity which does not sufficiently amaze us. In the very furnace of post-war prejudice Professor Einstein came from Germany to teach such few of us as could attain to his high summit of intellect the new mysticism of Relativity. While the politicians of yesterday and to-morrow argue about the political virtues and vices of France, the whole world unites in remembering Pasteur—a name whose mention makes international squabbles seem pitifully small-minded in the light of international indebtedness. The great German pathologists, Ehrlich and Koch, have saved as many Allied lives as German bullets have wantonly sacrificed, and we, with Lister and Pasteur, have returned a like service to balance the slaughter imposed on us. There has recently been published some important work in Physics, which was based on work done in Ruhleben during war imprisonment, with the help of German scientists, by an interned civilian. In short, the domain of science is at present the one assured home of a true international spirit.

* * * * *

Among the less well-known activities of the League of Nations has been its work for international science and health. We are sufficiently close to the influenza epidemic of 1918 to remember that it destroyed more lives throughout the world than did the war itself. There exists at present an international committee to investigate the problem of world epidemics. The question of the influence of the pilgrimage of Mohammedans to Mecca in spreading plague, typhus, dysentery and cholera has been fully investigated. It is no little danger that threatens Europe, when we consider that in 1913 no less than 98,000 pilgrims went to Mecca; that these diseases were rife among them and that many pilgrims returned to Constantinople, there to meet and mix with all the nations of the world in that border-town of the East. Typhus, it is true, is a louse-borne disease, and unlikely to invade cleanly countries; but its spread westward from Russia, where it is still common, was checked by frontier precautions which almost failed when a fresh "war" broke out not long ago along that line. Finally, in these days of vaccine treatment, a huge mass of unco-ordinated work has been done in many countries on the various sera used in dysentery, tetanus, diphtheria, and other diseases. Here, too, international work is in progress to standardise methods and doses, and to share the world's knowledge.

* * * * *

In this connection allusion must be made to certain correspondence in the *Nation* of December 2 and 9, 1922. Professor Harnack, a well-known German theologian, who was last heard of by the layman when he signed the notorious letter of German professors condemning the Allied cause early in the war, wrote deploring the great injury to German culture and science done by the post-war conditions in Germany. Books are unprintable; foreign journals (in this a correspondent to *The Times* bears him out) are not to be found in reference libraries; German science is losing touch with the world. He advanced the possibility of an English subsidy. Viscount Haldane, one of few prominent Englishmen who retained an unprejudiced mind towards Germany throughout difficult years, criticised this letter; he said that science advances most through difficulties, and quoted figures which tend to show that German science is not suffering at any rate in recruits. *The Times* points out that one technical school in Germany has more than doubled its pupils since the war. It would seem that England could scarcely be called upon to help German research, even on the most liberal ideals, until it had fully subsidised its own And that day is not yet. But

the difficulties of University libraries and other institutions of like nature in keeping in touch with the literature of science is a different problem—and one which a little imagination and trifling cost in England and other lately allied countries would easily solve. And if it be not solved, it is fairly certain that the loss to the sum of human knowledge, the set-back to medical science in its arduous battle against disease, and the stifling of the humane studies and arts, will involve this tortured generation in a new offence against the ages to come.

* * * * *

We are getting superior in our attitude towards elements, but the news of another one to add to their short list is of some interest, if only to the man who, with the stamp collector's instinct, wishes to see a set complete. Two observers from Copenhagen, Coster and Heresey, announced in *Nature* of January 20 their identification of a new element which they call Hafnium. Its discovery is in some respects romantic. In 1914 H. G. S. Moseley published his investigations of X-ray spectra of elements. It was well known that each element had a characteristic line in the spectrum —that is to say that, when the element was heated to incandescence and its light analysed with a prism, dark lines on the patch of colour are typical of that particular element. This fact has enabled us to ascertain the composition of the sun and remote stars ; but a fair amount of substance is necessary to identify an element by these means. The use of kathode rays, as they are called—the bombardment of a crystal by electrons from an X-ray tube—produces an equally characteristic spectrum on a sensitive photographic plate. This method, however, is available for minute quantities of the substance investigated and is very accurate. Not only that—Moseley was able to assign to each element a number, which he associated with the number of electrons which rotate round the core of the atom. In all ninety-two atomic numbers were assigned, but there were six blanks in his list. Sir James Walker prophesied that element seventy-two, one of the blank numbers, would resemble a rare metal zirconium—discovered in 1789—in its properties. This proves to be the case, for the new element has been traced by X-ray analysis in an ore containing zirconium. Elements forty-three and seventy-five, among others, still await discovery, and it is a remarkable fact that we know nearly all about them, their properties and their weights in comparison with other elements, from the work of Moseley[1] and his predecessors without ever having seen them. It is just possible, though improbable, that they do not exist on this planet of ours. If so, fresh opportunities await, maybe, the first man to reach Mars !

[1] *Introduction to Physical Chemistry*, 1922.

What are the Nebulæ?

An Astronomical Problem

By the Rev. Hector Macpherson, M.A., F.R.A.S., F.R.S.E.

Twentieth-century research with telescope, spectroscope, and camera has emphasised the division of the nebulæ into several sharply differentiated groups or classes. First of all, there are the bright irregular nebulæ, of which that in Orion is the most prominent ; secondly, and closely connected with these, the dark nebulæ ; thirdly, the planetary nebulæ ; fourthly, the spirals ; and fifthly, a class of small round objects which were formerly classified with the spirals, but obviously differ from them in many important respects.

I. The Bright and Dark Nebulæ

The discovery that the bright irregular nebulæ are gaseous gave powerful support to the view that they represented "worlds in the making," the material which would be, in the course of ages, wrought into suns and systems. This, indeed, appeared to be placed beyond all doubt by the association of these nebulous masses with the so-called "early-type" stars. This association is one of the indisputable facts of stellar astronomy. Wherever there is a great nebulous region, the earlier or the blue-white types of stars are found in an abnormally plentiful quantity, and the chances are fairly strong that some of the stellar spectra will contain bright lines. On the other hand, nebulæ and red stars do not exist near each other. In recent years, however, the aspect of the question has been completely altered by the formulation of Professor Russell's theory of stellar evolution. According to this hypothesis, which has been confirmed both by theoretical investigation and observational evidence, the blue-white stars are not the youngest stars, but are suns in their prime, in the meridian of stellar life. If the blue stars are not the youngest of the suns, what, it may be asked, is the nature and function of the diffused gaseous nebulosity ?

The question has been still further complicated by one of the most remarkable discoveries of recent years—that of the second class of nebular objects—the dark nebulæ. Herschel drew attention over a century ago to several dark spots in the galactic regions which he referred to as "holes in the heavens," and Sir John Herschel detected a number of others. During the last century it was believed that these dark spots were simply regions free from stars, and it is probable that a number of them do represent vacant spaces. In 1902, however, Professor Max Wolf remarked on their symmetrical arrangement in regard to the stars

THE GREAT NEBULA IN ORION.
(*Photo by Dr. Max Wolf.*)

and visible nebulæ in their vicinity. He drew attention to a bright nebula in Cygnus, "placed centrally in a very fine lacuna, void of faint stars, which surrounds the luminous cloud like a trench. The most striking feature with regard to this object is that the star-void halo encircling the nebula forms the end of a long channel, running eastward from the western nebulous clouds and their lacunæ to a length of more than two degrees"; and he asked the question: "Is there a dark mass following the path of the nebula, absorbing the light of the fainter stars?" Dr. Wolf was gradually led to the opinion that these dark objects were not vacant spaces, but were actually composed of dark gaseous matter.

More recently Professor Barnard has published a catalogue of these objects, and there can be no doubt that they are actually great patches of obscuring material. Dr. Hubble, of the Mount Wilson Observatory, who has closely investigated these regions of obscuration in recent years, believes that the division in the Milky Way between Aquila and Ophiuchus is apparent only and is due to the presence of dark nebulosity. In a recent paper the Rev. Father Hagen, of Rome, has maintained that this dark nebulosity is much more extensive in all parts of the heavens than has hitherto been believed. At all events the bright and dark nebulæ are closely akin. In some cases, as Professor Russell remarks, "these regions of obscuration merge into faintly luminous nebulosity," and according to him, it is from these dark nebulous masses that the most youthful stars—the diffuse red giants—generally spring.

The view that stars are developed from the bright nebulæ was questioned as long ago as 1902 by Professor T. J. J. See, who suggested that "perhaps nebulosity may be expelled from the stars and does not really afford the basis out of which they are constituted," and in 1918 Professor Russell remarked on the probability that "the nebulæ as visible objects owe their existence to the radiation of the stars and are their offspring and not their parents." In a recent paper on "Dark Nebulæ" communicated in May 1922 to the National Academy of Sciences at Washington, Professor Russell shows that the normal nebula is the dark nebula—a dark cloud in space—and that the bright nebula is only a particular case. "The transition from these dark nebulæ to luminous nebulæ in the vicinity of the stars," says Professor Russell, "appears to occur in two ways. One is by simple reflection of the light of the stars," while the second is "by the excitation of gaseous emission."

This would indicate that there are two sub-classes of luminous gaseous nebulæ—a conclusion which is confirmed by actual observation. In 1914, a spectroscopic study by Dr. V. M. Slipher, of the Lowell Observatory, of the nebulæ in the Pleiades surrounding the bright stars Merope and Maia showed the spectra to be continuous—identical with the spectra of the two bright stars. The conclusion from this is that the nebulosity is inherently dark and shines by reflected light. Since then numerous other instances of this have been detected. Recent work at Mount Wilson has demonstrated the intimate relation between the types of nebular spectra and of the stars involved, and this relation, it is stated, in the most recent "Report" of the director, "demands that one be

considered a consequence of the other, or that both be due to a common cause. It suggests that one source of nebular luminosity may be found in some influence emanating from associated stars that fall within certain ranges of spectral type and hence probably of effective temperature."

In the Orion nebula, Professor Russell points out, the stars of the Trapezium appear to be the source of excitation, but he concludes that "there is no reason to believe that the luminous gas forms the whole or even any large part of the matter present within the region—only that it is selectively sensitive to the incident excitation, and therefore gives out most of the light, just as the gases (carbon compounds and nitrogen) do in the coma and tail of a comet." Bright nebulæ, then, are simply particular examples of the normal dark nebulæ which seem to constitute the primeval chaos of which the stars are born.

II. The Planetary Nebulæ

The great extended nebulæ—bright and dark—appear to be almost at rest in space. This is in marked contrast with the planetary nebulæ, whose average speed as determined by the spectroscope is about forty-eight miles per second. These "planetaries," so named by their discoverer, Sir William Herschel, from their resemblance to planetary disks, form indeed a small and select class, sharply differentiated from the other types. Like the irregular and dark nebulosities, they congregate towards the galactic plane, and they are truly gaseous, as Herschel believed them to be. But their regular contour and rapid motion, as well as their comparatively small number—only about 150 are known—mark them off as a class apart. They are almost always distinguished by the presence of a central star, so that from one point of view these may be regarded as stellar rather than as nebular objects. They are closely related to the rare type of star known as Wolf-Rayet stars, which are characterised by bright lines in their spectra. Indeed, remarked Dr. Wright, of the Lick Observatory, in 1914, "there is no escape from the conclusion that the nuclei of planetary nebulæ not only are closely related to Wolf-Rayet stars, but in many cases they are such stars." The parallaxes of six planetary nebulæ have been measured by Mr. Van Maanen, of Mount Wilson, within the last few years, and he finds the mean absolute magnitude of these stars to be + 9·1, indicating them to be dwarfs.

Dr. H. D. Curtis, of the Lick Observatory, has recently suggested that the planetaries are to be regarded as "a somewhat sporadic case in stellar evolution, arising through some collision or cataclysm and not to be regarded as cases typical of the general run of stellar development." Considerable support is to be found for this view, not only in the rarity of the planetaries and their enormous velocities, but also in the connection between such nebulæ and temporary stars. Since the application of the spectroscope by Huggins to the "blaze star" of 1866, it has been found that the spectrum of a temporary star, "or nova," passes through several well-marked stages. In every case the nebular spectrum appears at a certain period in the decline of temporary stars. The nebular stage, however, seems to be only a transient one. In 1902 Pickering found the spectrum of Nova Persei to be identical with that of a planetary nebula. Five years later Hartmann, at Göttingen, found it to be essentially identical with that of a Wolf-Rayet star. In July 1914 Adams and Pease, at Mount Wilson, found that Nova Aurigæ and Nova Persei had changed into Wolf-Rayet stars, and by April of the following year a similar transformation had taken place in the case of Nova Lacertæ and Nova Geminerum No. 2. In their paper announcing these changes, Adams and

THE GREAT SPIRAL NEBULA (M 51) IN CANES VENATICI.
(*Photo by Dr. Max Wolf.*)

Pease remarked that "this identity of spectrum, taken in connection with the well-known agreement of distribution relative to the Milky Way of Novæ and Wolf-Rayet stars, makes it probable that at least a portion of the latter are temporary stars in the later stages of their history." On the hypothesis of temporary stars due to Professor Seeliger, these novæ are caused by the rush of feebly-luminous stars through masses of invisible nebulosity, and the nebular and Wolf-Rayet stages may be successive stages in the passage and emergence of stars into and out of such nebulosity. Be this as it may, there is much to be said for the suggestion that the planetary nebulæ are "the wrecks of ancient novæ."

III. The Spiral Nebulæ

The problem of the spiral nebulæ has bulked very largely in recent astronomical thought. The greatest of the spirals is the great nebula in Andromeda, which was known before the invention of the telescope, but its spiral form was not discerned until after the application of photography; so the recognition of the spirals as a distinct class is due to the great Rosse reflector, and the classic instance was that of the famous object (M 51) in Canes Venatici.

About twenty years ago, after Keeler's startling announcement concerning the profusion of these objects, the prevalent view was that, in the spirals, suns and systems were to be seen forming under the eye of the observer. Indeed, the famous planetisimal hypothesis of evolution was based on the assumed gaseous nature of the spiral nebulæ. About a decade ago, however, opinion veered round to the view that the spirals were not true nebulæ at all, but irresolvable clusters at vast distances from our galactic system. In 1911 Professor F. W. Very revived the "island universe" theory, which derived considerable support from the numerous differences between the spirals and the other members of the nebular family. The average velocity of the spirals is about twenty-five times the average stellar velocity, and Dr. Shapley has remarked that as a class—"apparently regardless of the gravitational attraction of the galactic system"—they are moving away from the stellar system. Further, the discovery in 1917, on photographs of spiral nebulæ, of a number of faint temporary stars gave plausibility to the idea that such might be the novæ of distant galactic systems.

Thus the available evidence about five or six years ago seemed to point to the view that the spirals were not true nebulæ at all, but external universes which are too far away for the component stars to be separately discerned. This view seemed highly probable and indeed likely to prevail; but more recently the work of Van Maanen, Lampland, Shapley, and others has thrown grave doubts upon its validity. Mr. Van Maanen and Mr. Lampland have succeeded in measuring the motions of internal points in the nebula Messier 101. Dr. Shapley truly remarks that these measures "would indicate rotational velocities greater than the velocity of light, if that spiral is held to be even one-fifth as large as our galaxy now appears to be." Finally, Dr. Shapley points out that "if in real dimensions spiral nebulæ were analogous to our galactic system, the absolute magnitude of the novæ in spirals would far transcend any luminosity with which we are acquainted, and would be at direct variance with present results on intrinsic stellar brightness."

Accordingly, we seem compelled to regard the spirals as nebulous objects, closely connected with our stellar system. Shapley has suggested that "the spirals represent the failure to form stars from the original condensing nebulosity through the presence of too much material." On this hypothesis the spirals are composed of the unused material driven away towards the poles of the galaxy by the radiation-pressure of the stars, and would be, in a sense, analogous to the cometic and meteoric matter in the Solar System. This is not out of harmony with Dr. See's ideas that "if repulsive forces are everywhere at work expelling dust from the stars for the formation of nebulæ, it is evident that as it is repelled by the stars, it will tend to gather especially in vacant regions or spaces remote from the stars and should accumulate with maximum density near the poles of the Milky Way."[1] On Dr. See's view, however, the nebulæ are not waste material, but true nebulæ, the progenitors of suns and systems. According to Dr. Jeans, the spirals are undoubtedly such, and the "condensations" which are visible in them are the stars of the future. These enormous nebulæ, he justly maintains, cannot develop into Solar Systems, but into "streams of stars." Indeed, Dr. Jeans contends that the process of evolution is actually taking place and that its rate is to be calculated by the internal motions which Van Maanen, Lampland, and others have measured. In the case of the spiral M 101, at a distance of 5,000 light-years, Dr. Jeans finds that "this mass is, under the influence of increasing rotation, breaking up into streams of stars. Each star is of mass comparable with our sun, and the stars are generated at the rate of one every few hundred years."

The alleged extraordinary profusion of the spirals has long constituted a formidable problem. They have, for instance, been estimated to number from eight hundred thousand to a million. In 1919, however, Mr. J. H. Reynolds, the English astronomer, put forward certain objections to the view that all the small

[1] This view finds support in the theory of Professor Russell outlined in his paper on dark nebulæ.

white nebulous objects are actually spiral nebulæ. He drew attention to the existence among them of small round nebulæ "which are to be numbered by the thousand and probably actually form the majority of the known nebulæ." Confirmatory evidence of Mr. Reynolds's contention has recently been obtained at the Mount Wilson Observatory. Indeed, in the recent *Annual Report* it is stated that "the non-galactic objects which have been designated as globular nebulæ are more numerous than those of any other class. The brightest and largest of them, such as M 43, 60, and 87, show no trace of spiral structure, although their spectra and radial velocities are of the same character as those of the spirals." Mr. Plaskett, of Ottawa, has suggested that from these nebulæ the giant stars develop in accordance with Professor Russell's hypothesis.

At the present time, current theories and opinions as to the nebulæ are in the melting-pot. The advances of the last few years have enormously added to our knowledge, but have made the task of co-ordinating the known facts in a general evolutionary concept much more formidable than it was believed to be twenty, or even ten, years ago. On the other hand we have the fact that Professor Russell's hypothesis of stellar evolution fits the known data much better than any other cosmogonic theory and, further, this hypothesis points to the great dark nebulæ, of which the bright irregular nebulæ are merely particular examples, as the progenitors of the red giant stars. On the other hand, we have the fact that the evidence also favours the evolution of stars from spiral nebulæ, and further that the planetary nebulæ would also appear to be the parents of stars. At the present time, therefore, the evidence seems to point to the likelihood of there being two or three possible paths of evolution, a fact which would add meaning to the proved existence of widely different forms of nebulæ. The intensive work now being carried on at the great American observatories may be expected to throw further light upon the question within the next few years; and the apparently contradictory facts of to-day may be merged in a higher synthesis in the near future.

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A Test of Relationship

By R. J. V. Pulvertaft, B.A.

In 1871 a certain Arthur Orton, the son of a Wapping butcher, underwent trial for more than a hundred days on a charge of posing as the rightful heir to the Tichborne estate. A succession of witnesses were found ready to swear to his identity. Even the mother of the real heir, drowned at sea, recognised him as her son. Although Orton was fair and Tichborne dark, although Tichborne's accent was French and that of Orton very reminiscent of Wapping, there was very great difficulty in establishing the truth.

Such claims as Orton's are by no means rare in courts of law. The question of the relationship of a child to its supposed parents very often arises, as, for instance, in the Meade Divorce case settled a few weeks ago, and, again, especially when large sums of money depend on the birth of a child. And that relationship is notoriously difficult to establish. Famous artists are called upon to swear to resemblances between the shape of the parent's ear and that of the child; arguments are based on the colour of the eye and hair. But everyone realises that such arguments carry little weight; mere resemblance in feature is not convincing.

There is, however, one test which may prove reliable in questions of this sort. It was shown many years ago by Mendel, an Austrian priest, that certain peculiarities of sweet-peas were handed down in a definite manner to their descendants. In other words, a knowledge of the characteristics of the parent plants of a packet of sweet-pea seeds enables a gardener to prophesy all the possible varieties of sweet-pea which he can grow from that packet. And if those sweet-pea seeds are very crinkled, he knows that at least one of the parent sweet-peas grew also from crinkled seeds.

If we could find a single peculiarity of human beings which is handed down without any possibility of an exception, we could prove, in many cases, whether a child was or was not related to its supposed parents. We know, however, what unexpected children occur—red-haired from dark-haired parents, tall from short, and clever from foolish. Therefore none of these characteristics can fairly influence a decision—they are not "dominant" charcteristics in Mendel's phrase; they are characteristics which arise from the fact that human beings, as a recent writer[1] in DISCOVERY has said, are "mosaics of inheritance."

As a matter of fact, there are several characteristics which are handed down from parent to child as

[1] Prof. H. J. Fleure, *Mental Characters and Physical Characters in Race Study*, in the February issue.

the property of tallness is handed down in sweet-pea families. The most noteworthy, perhaps, is a condition in which the blood of the person affected does not readily clot, and these persons run a grave risk even where a slight operation such as the removal of a tooth is necessary. This state of affairs is known as "Hæmophilia," and, although everywhere rare, is relatively common in Germany, and unknown in the tropics. Males alone are affected, but females transmit this peculiarity; before the war many of the royal families of Europe had "hæmophiliacs" among their number.

Other such conditions are colour-blindness—also more common in men than women, and transmitted through women; night-blindness, and other forms of abnormal eyesight.

The presence of any of these conditions in a child would be strong evidence of relationship to a supposed parent who also manifested the peculiarity. But all of them are rare; some of them for example, the condition in which blood does not clot—do not appear until a child is two years old; and colour-blindness is a feature which it would be difficult to establish in a court of law. These facts render the possible usefulness of arguments based on such inherited characters rather small. We obviously require a hereditary characteristic which is common to all men, but capable of some degree of variation.

It is suggested by Dr. S. C. Dyke [1] that we have such a test of relationship in certain peculiarities of the blood. For many years it has been recognised that when it becomes necessary to transfuse blood from a healthy person to one who has lost a great deal, care must be taken lest the remedy be worse than the disease. The blood of some people is not compatible with that of others, and fatal results have occurred. Investigation shows that these accidents are due to the fact that the clear fluid of the blood of some people has the property of making the red blood cells of other people collect together in colonies.

A simple test has been devised whereby we can group individuals under one of four classes according to the reaction of their blood cells to the clear fluid of other individuals. In England a large proportion of the population comes under the same group, but as one travels east, the proportion gradually changes, until the group most strongly represented in England is least represented in India. In fact, researches have been undertaken with a view to determining the origins of nations and their varied constituent races by this test.

It appears that in these groups we have characteristics which, unlike red hair or eye colour, can really guide us to a decision on the point of parentage. For example, if both parents belong to Group 2, the children must belong to Group 2 or Group 4; if a child belongs to Group 1 or Group 3, it is not the child of these parents.

However, the application of this test is only a limited one. In the first place, one of the groups, as has been mentioned, is scantily represented in England, and this fact narrows the possibilities of the case greatly. Again, the majority of legal cases of this nature involve a position where one parent is acknowledged, and the only question concerns the other. In such circumstances the possibility of a decisive result is small. But if it proves of use in only a few cases, it will provide an answer to one of the most tangled questions which come up for decision in the courts of law—provided always that the legal mind, with its cautious prejudice against scientific proof, can be brought to accept it.

[1] *Lancet*, December 16, 1922.

Oxygen and Violent Exercise

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A LIVING body, even a piece of isolated muscle, is never, chemically speaking, "at rest." Apart from movement of any kind, an incessant progress of chemical change is necessary, to maintain that state of organisation of molecules, of readiness and power to react to a stimulus, which is regarded as one essential property of life. This chemical change is sometimes of an upward or constructive type in which complex bodies are made from simple ones; chemical energy can then be stored at the expense of energy from without. But at other times life is accompanied by a downward or destructive change in which the chemical energy previously stored is degraded. In the muscle of a frog, which by suitable treatment may be kept "alive" (in the sense that it will contract when excited) for as long as a month after removal from the body, there is a continual evolution of heat, a production of the gas carbon dioxide, and a utilisation of oxygen. This heat is given out at the rate of about three-tenths of the ordinary unit of heat (the gram-calorie) per hour for every gram of muscle when the muscles are kept at about 15° C., is greater when the temperature is higher, and less when the temperature is lower, being increased (or decreased) two or three times by a rise (or fall) of ten degrees. Now it is well known to chemists that the rate at which a chemical reaction goes is similarly affected by a rise or fall of tempera-

ture. There can be no doubt, then, that, whilst "resting" the isolated muscle we are talking about is undergoing the chemical change of oxidation, necessary, so to speak, to keep the fires of life burning inside the living cell.

Death and Recovery

If the muscle be deprived of oxygen it dies much sooner, but it does not die at once. The rate at which heat is produced falls to a certain amount and then remains constant for many hours. During this phase part of the substance glycogen stored within the muscle is converted into the substance lactic acid, and ultimately the muscle dies in *rigor mortis*, due to the accumulation of lactic acid. If, however, before dying it be supplied again with oxygen, the rate at which heat is produced rises not merely to its original value, but to a higher one, the excess of heat evolution making up for the deficit during the earlier lack of oxygen. The muscle in "recovering" uses not only its former income of oxygen, but also the amount that it would normally have taken during the time it was prevented. During the recovery also the accumulated lactic acid disappears and the glycogen from which it arose is largely restored within the muscle cells.

In the resting muscle, then, it is clear that two processes connected with life are occurring: (1) a process not requiring oxygen which leads to the production of lactic acid from the carbohydrate glycogen; and (2) a process requiring oxygen which leads to the disappearance of the lactic acid and to the restoration of the carbohydrate. In resting life, in presence of sufficient oxygen, these two processes appear superficially to be one, but, by first depriving the muscle of the necessary oxygen and later restoring it, it can be shown that the normal process of oxidation occurs in two stages, the initial or "anaerobic" phase and the recovery or "oxidative" phase. The first of these "sets the pace" for the whole process; the recovery phase merely follows and completes the initial breakdown.

The Function of Oxygen

By writing down chemical formulæ it is not difficult to show how the quantity of carbon dioxide produced by a muscle in presence of an adequate supply of oxygen corresponds exactly to the oxygen used, and equally whether it be lactic acid or the carbohydrate that is oxidised. These facts may be taken for granted. In the muscle without oxygen, lactic acid, as has been said, is produced from glycogen, the glycogen changing into no other chemical compound. This change is accompanied by a production of heat. In the recovery phase, however, although all the lactic acid vanishes and glycogen appears again, the change is not a complete transformation of one into the other, for a portion of one or of the other is oxidised to supply the energy lost as heat in the earlier phase. It is usual to suppose that it is a portion of the lactic acid which is oxidised for this purpose, and if this is so, we calculate that five-sixths of the lactic acid is changed into glycogen and the remainder oxidised.

The same clear division of the breakdown process into two separate phases can be detected in a muscle which is stimulated. An isolated muscle at rest in oxygen contains very little lactic acid; the more accurately the estimation be made, the less appears to be the lactic acid present. If, however, it be stimulated electrically, heat is produced, and relatively large quantities of lactic acid are formed. If the stimulation be continued, it is found that a maximum amount is eventually formed which is about 0·25 to 0·4 per cent. of the muscle's weight, depending upon conditions. If the muscle can be kept alkaline, for example, more lactic acid will be produced than otherwise. If now such a muscle be left in oxygen, the lactic acid disappears, oxygen is used, heat and carbon dioxide are formed; one-sixth of the lactic acid being oxidised, the remainder transformed into glycogen. This is exactly as in the muscle "recovering" at rest from oxygen deprivation. Moreover, other tests have shown that the chemical change in the first phase is totally uninfluenced by the presence of oxygen in any way; oxygen is used, but entirely in the second phase, the recovery. Here is, then, one of the most important generalisations of chemical and physical biology, for it is probably as true of every kind of tissue as of muscle: *Oxygen is used by the living cell only in what, properly speaking, may be called recovery processes.*

Credit and Security

The occurrence of oxidation is a necessary accompaniment of all the higher forms of life: continued activity is entirely dependent on an adequate supply of oxygen. To take an analogy from economics: business activity is always accompanied by the surrender of one's own goods in exchange for those of someone else: continued activity is entirely dependent on an adequate production of goods suitable for exchange. In most businesses, however, occasions of special need or opportunity occur, when it is necessary to incur liabilities greater than can be covered by the contemporaneous production of exchangeable goods. Here, on the "security" of other assets, not so readily exchangeable, a "credit" is obtained to meet the special need. So it is in the body. If the organs of the body were capable only of exerting activity covered by their simultaneous supply of oxygen, then that activity would be very limited, no great effort could be made, no exceptional need met

or opportunity seized. Fortunately Nature has arranged that very violent efforts can be made, that the body need not be content with its oxygen "income," but that it can obtain a "credit" for future oxygen, can (so to speak) "run into debt" for oxygen, by the agency of the lactic acid which it releases as a "security" for future oxidation. The extent of this "credit" depends upon the lactic-acid-maximum, and that depends upon the content of available alkali of the muscle tissue.

We have arrived then at two important generalisations, which appear to be established beyond dispute: (*a*) that oxidation follows, and does not accompany or precede, muscular activity; and (*b*) that the muscle, if its oxygen "income" be not adequate to its momentary need, can obtain a considerable "credit" for oxygen to be taken in later, on the "security" of the lactic acid which it liberates within itself.

Muscle as a Machine

As to the function of this lactic acid, we are on more speculative ground. It appears certain, at any rate, that the acid provides part of the mechanism of the machine, as well as the fuel to supply it with energy. In a steam engine the coal is merely there as fuel; the steam is, so to speak, part of the mechanism itself, it moves in and out in the cylinder and through the valves, it applies a force to the piston. In an internal combustion engine the gas is the fuel, its combustion provides the energy; it is, however, part also of the mechanism, it moves in and out and applies a force to the piston. In that sense the muscle resembles the internal combustion rather than the steam engine; its fuel—lactic acid—is also part of the machinery. In the internal combustion engine, however, all, or nearly all, the gas admitted to the cylinder is burnt; in the muscle, only one-sixth of the lactic acid is oxidised, the rest is restored to its original state. For another reason, however, the analogy cannot be pressed. For, although in the mechanical engineering sense the muscle is as efficient as the best gas engine ever made, it is not a heat engine. A heat engine needs a difference of temperature through which to work; a muscle is throughout at uniform temperature. The muscle acts indeed *because it changes chemical energy directly into work at uniform temperature.* In action it is really more like the combination of two dry cells and an accumulator. In lighting a lamp, or in any other work for which it is used, an accumulator runs down, the lead and the lead peroxide in it being changed into lead sulphate; in "recovery" the chemical energy stored in the dry cells charges the accumulator by restoring the lead and lead peroxide from the lead sulphate. But this analogy, too, is incomplete.

To reconstruct even in outline a physical picture of the processes which occur in muscle leads to many details of a highly technical nature. It would seem probable, however, that many of the events occurring in a muscle in action or at rest, can (or will shortly) receive a reasonable and consistent explanation, in terms of the processes of physical chemistry.

We have spoken hitherto of the isolated muscle, at rest or in activity. The same principles, however, apply to the case of a man taking exercise. It is not possible to record, without lag, the heat-production of a living human muscle; nor is it practicable to determine the lactic acid present in it. By suitable means, however, consisting of a mouthpiece, a pipe and a bag, it is easy to allow a man to inhale ordinary air of known composition and to collect all his expired air in the bag; then a measurement of its volume, and an analysis of its contents, will enable us to calculate the consumption of oxygen during even the most strenuous exercise. Many interesting results can be obtained with this method, which, although in practice somewhat laborious, is in principle simple and reliable. We will consider only a few of these.

Oxygen Consumed in Exercise

From the moment a man begins to make a violent effort his respiration is rapidly and enormously increased. At rest in bed the total air breathed per minute by a man of 70 kilos (11 stone) body-weight may be only about 6 litres (about $1\frac{1}{2}$ gallons); running at 12 miles per hour it rapidly rises to 120 litres or more. This increase is not caused primarily by lack of oxygen, but rather (*a*) by the increased production of carbonic and lactic acids acting on the so-called "respiratory centre" in the nervous system, and (*b*) by other less tangible nervous influences due either to consciousness of the effort or to reflex action caused by it. The rate of oxygen consumption, however, rises rapidly if the exercise be continued. Starting at (say) 200 c.c. per minute when at rest, it rises to a certain maximum value, characteristic of the violence of the exercise, attaining this maximum to all intents and purposes within two or three minutes. The more severe the exercise, the greater is the final maximum rate of oxygen-consumption associated with it; beyond a certain limit, however, the mechanism for supplying the oxygen fails; in other words, the lungs, blood, heart, and arteries have attained their maximum activity, and no greater supply of oxygen can be secured, however much it be required. Consequently, in all forms of violent exercise, after a certain limit the body has to "go into debt" for the oxygen it needs, over and above the amount it can obtain at the time through the usual channels. This oxygen it takes in later, after the exercise has ceased

or slackened. Everyone knows that severe exercise is not only accompanied, but followed, by severe respiration, and in this subsequent "recovery process" considerable quantities of oxygen are taken in; indeed, recent experiments in Manchester by two colleagues of mine (Messrs. Lupton and Long) have run this "recovery oxygen" up to 10 litres, enough to maintain a man in bed for nearly an hour! Actually, of course, a man cannot lie in bed without oxygen for an hour; his brain and heart require a continual supply of oxygen. But it is a striking fact that by severe exercise lasting for less than a minute a man may incur a debit balance of oxygen which would be sufficient to keep him comfortably in bed for about an hour. Looked at in another way, 10 litres of oxygen cannot be supplied through the circulation in less than about $2\frac{1}{2}$ minutes, even with the most violent respiratory effort. Thus in less than a minute it is possible to incur a debt which it will take one's heart and lungs $2\frac{1}{2}$ minutes to repay, even when working at their hardest; for a short time one may expend energy several times as fast as one could possibly do if one were dependent on a simultaneous supply of oxygen. *These facts illustrate the advantage to the body of the latitude allowed by the system of paying later on for its efforts in the immediate present.*

Athletic Records

Let us now consider some world's athletic records, and the conditions affecting them. The Amateur Athletic Association, I believe, "passes" records made upon the track; the Physiological Society ought to undertake to "pass" records made in the laboratory! There are two quantities in which the world's records are of fundamental physiological interest: (*a*) the maximum oxygen debt which it is possible for a man to incur, and (*b*) the maximum intake of oxygen per minute during severe exercise. Both, properly speaking, should be reckoned per kilogram of body-weight, though this has not been done here. Both records are held by members of the University of Manchester, one by a Professor and the other by a Bachelor of Science. It might advance physiological knowledge were Oxford and Cambridge to give a "full blue" to oxygen-intake representatives, and a "half blue" to those able to incur the greatest debit balance (of oxygen); such contests might even be included in the Olympic Games. It is quite certain anyhow that the Professor and the Bachelor of Science will soon be ousted from their present proud positions as holders of world's records.[1]

[1] The Professor's record still stands, but the Bachelor's record has been beaten by over 3 litres, by a Y.M.C.A. sportsman of forty-six years.

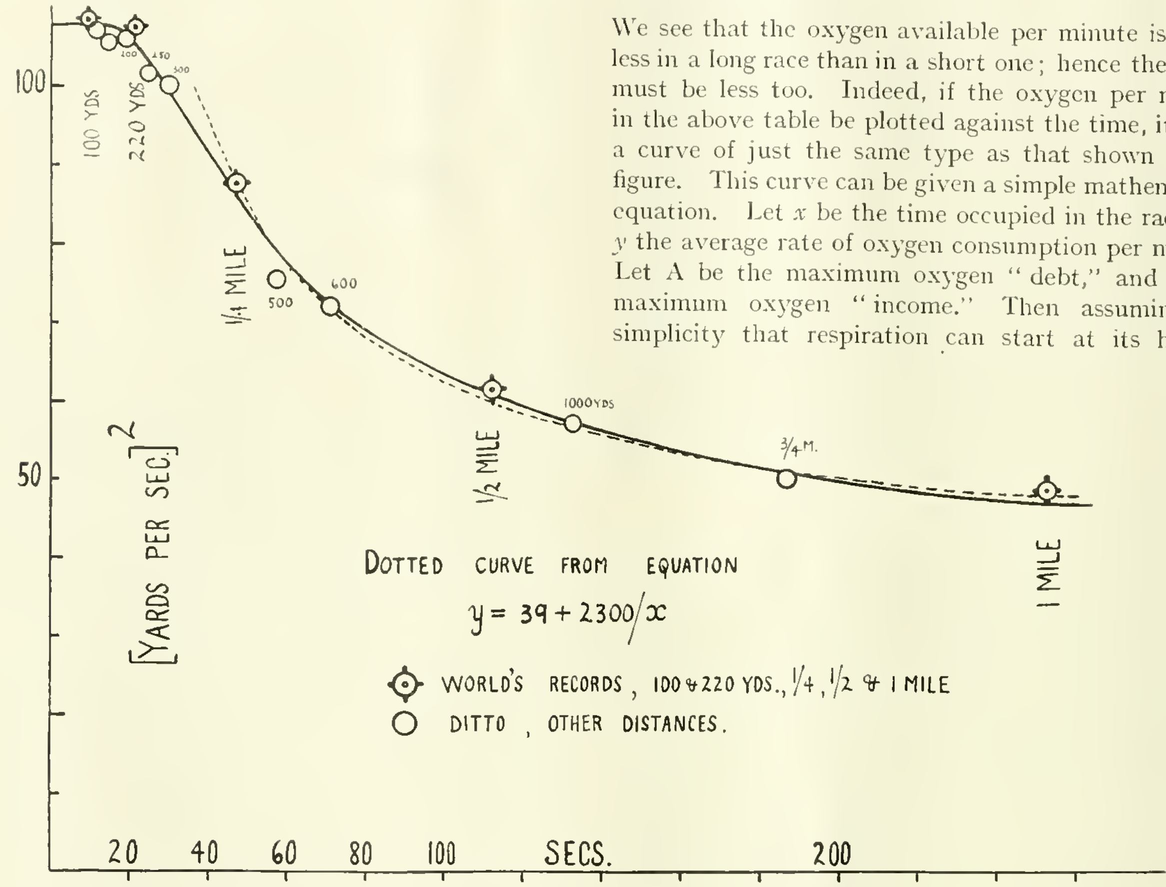
Let us consider what these records mean. The Professor, who weighs 73 kilos, has managed, by vigorous running, to utilise 4,175 c.c. of oxygen in a minute. Assuming 1 c.c. of his arterial blood to contain about 0·185 c.c. of oxygen—the normal amount—and 1 c.c. of his mixed venous blood to contain about 0·650 c.c. of oxygen—it could not have contained much less—then every 1 c.c. of his blood, as it travelled round his body during the exercise, must have lost 0·12 c.c. of oxygen. Thus to take in 4,175 c.c. of oxygen it must have required about 35 litres of blood to pass through the heart and lungs per minute—a mass of blood equal to that of half the body every minute! There are few water taps which will turn out 35 litres (9 gallons) every minute, and yet the heart can do it, probably in a first-class runner for an hour on end; it is small wonder that the heart is one of the parts most likely to fail when the machine is overloaded. Of course there are not 35 litres of blood in the Professor's body—probably only about 5—so that the whole of it has to circulate seven times every minute.

The record held by the Bachelor of Science is 10 litres; by extremely violent jumping over a stool in a cellar (strange things happen in physiological laboratories) he produced fairly complete exhaustion, and in the succeeding 10 minutes took in 10 litres more of oxygen than he would have needed had he remained at rest. He must have produced not far from the lactic-acid-maximum in his muscles. Now these two gentlemen are admittedly world champions only on false pretences; merely because no first-class athletes have tried to oust them from their championships. There can be little doubt that W. G. George in his prime, or even our present-day mile champions, could put up a record of at least 5 litres per minute for the intake, while a half-mile champion "run out" to the last ounce could probably incur an oxygen debt of at least 15 litres. This is prophecy; but, were betting not forbidden by the rules of the A.A.A. (if not, at present, by those of the Physiological Society), I should be prepared to back the prophecy with cash!

The Limit of Speed

Let us now consider some further world's records—the times of the flat races from 100 yds. to a mile. Suppose a man to run on the level at a constant measured speed, and let us determine the value of his oxygen consumption *per metre travelled*. We all know that it is a greater effort to run 100 yds. fast than to run it slowly, and it is found that the oxygen consumption increases with the speed. Indeed, the oxygen needed *per metre travelled* is approximately proportional to the *speed*. Hence, the oxygen needed *per minute* should be approximately proportional to

the *square of the speed*. In the figure are shown the world's records, taken from *Whitaker's Almanack*, of flat races from 100 yds. to 1 mile. Horizontally are plotted the times occupied in the race, vertically the squares of the average speeds at which the record was made. The curve joining the points is a fairly smooth one, though it is noticeable that the principal records (100 yds., 220 yds., $\frac{1}{4}$, $\frac{1}{2}$, and 1 mile) lie rather above the curve as a whole. More effort has been expended



on these records, and it is harder to beat one of them than one of the others; indeed, simple inspection of the curve shows that the easiest records now available, for any enterprising and scientific would-be record holder, are those for 150 and 500 yds. What, however, is the cause of the general form of the curve? It is simple to show that, apart from one factor, the principles we have discussed above (of oxygen "income" and oxygen "credit") provide a satisfactory general explanation.

In the first place, the reader will notice that, in the figure, we have plotted the *square* of the average velocity; as we have pointed out above, this quantity is proportional approximately to the rate of oxygen consumption per minute, so that in effect the figure gives approximately the relation between the rate of oxygen consumption (*not* supply) and the time occupied in the race. Now if the maximum oxygen "income" of a world's-record-holder be 5 litres per minute, and his maximum oxygen "credit" be 12 litres, then in various times he can take exercise equivalent to the following quantities of oxygen:

Time: minutes . .	1	2	3	4	5	10
Total oxygen available: litres	17	22	27	32	37	62
Oxygen per minute: litres .	17	11	9	8	7·4	6·2

We see that the oxygen available per minute is much less in a long race than in a short one; hence the speed must be less too. Indeed, if the oxygen per minute in the above table be plotted against the time, it gives a curve of just the same type as that shown in the figure. This curve can be given a simple mathematical equation. Let x be the time occupied in the race and y the average rate of oxygen consumption per minute. Let A be the maximum oxygen "debt," and B the maximum oxygen "income." Then assuming for simplicity that respiration can start at its highest value immediately "on the pistol," and that the runner runs at a constant speed (both only approximately true), the following relation must hold:

$$\text{Total oxygen} = yx = \text{A} + \text{B}x$$
$$\text{or} \quad y = \text{B} + \text{A}/x.$$

In the figure an equation of this type, represented by the broken line, is shown to fit the curve with reasonable accuracy. It is noticeable, however, that at short times the relation does not hold at all. The reason is obvious. In the shorter races it is impossible to exhaust all the oxygen available, even in the most violent effort; the limit is imposed here *not by the oxygen supply, but by the sheer capacity of the muscle*.

There is one fundamental weakness in the data used

in drawing the figure, viz. that all these records were made by different persons, presumably with different A's and different B's, i.e. different "credits" and different "incomes." It is hoped, by consultation with, and experiments on, a number of good athletes, to draw up a standard average curve of the same type for (say) a good mile runner, running all distances over the range considered. A good 100-yds.-runner usually cannot, or will not, run a mile at all! Moreover, by a series of experiments on such athletes, it should be possible to make a reasonably accurate statement of the real relation, at all speeds, between the rate of oxygen-consumption and the speed. The former is certainly not exactly proportional to the square of the latter. For the present, however, it would seem that the general principles are correct, and that the speed and power of human muscular effort are mainly limited by considerations of oxygen "income" and "credit." The further exact investigation of these facts will add greatly to the scientific interest of athletics, and so will bring another valuable source of experiment and observation within the reach of those who are studying human function and activity. It is not contended that these considerations of oxygen and energy are the only ones; there can be no question of the importance of technical skill and training in the use and correlation of one's muscles and limbs, of tactical judgment in the actual race or effort, and of the mental and moral aspects of what athletes call "guts," that most intangible and yet most certain aid to athletic success or bodily prowess. Neither can any one of the physiological functions of the body be left out of account. Given all this, violent muscular effort still consists mainly in the degradation of energy, and this aspect of it gives us the clearest and most definite picture of its essential nature.

Garibaldi's Bride of an Hour—A Postscript

By Thomas Okey, M.A.

Professor of Italian in the University of Cambridge

[The interest aroused by Professor Okey's narrative in the last number of Discovery of this hitherto almost unknown episode in Garibaldi's life was very considerable. In this small postscript Professor Okey offers to our readers two photographs of the remarkable woman who acted as a messenger for the Garibaldians, nursed the great hero, and married him, only to be deserted by him within an hour after the ceremony. On whose side lay the greater degree of blame for the tragedy is a question which will probably never be decided.—Ed.]

Owing to the good offices of Signorina Emma Bellati, and through her friends in Italy, I am enabled to offer to the readers of Discovery copies of two existing

photographs of *la bella Giuseppina*. The sitting, full-figure is the nearer, as may be easily seen by the dress, to the period of the Garibaldi drama. The

photograph was taken at Zurich, and is the property of a friend of the family. The second portrait, taken later at Milan, admirably portrays, according to one

who knew her well, the singular charm, beauty, and goodness of Donna Raimondi's personality—a nature, sweet, generous, and kind, which won the sympathy and affection of all who had the good fortune to meet her. Among the common people she was beloved to the end of her days.

This second portrait is of historical interest. When Donna Giuseppina fled from her father's villa after the stormy scene with her bridegroom in the garden, she rook refuge at the factor's house at Gironico, where she was sheltered and caressed by his wife during those heart-breaking and sorrowful days. To this friend in need Donna Raimondi, in token of her enduring gratitude, gave the photograph here reproduced.

Between the Covers

RACIAL VARIETIES IN OUR POPULATION

Methods of living, types of speech, mannerisms are not the only forms in which the difference in racial stocks between one county and another, and often between one village and another, proclaim themselves to him whose business takes him continually from one district to another in England. In his newly published book, *The Races of England and Wales* (Benn Bros., Ltd., 5s.), Professor H. J. Fleure has summarised the main conclusions of recent research on an intensely interesting subject. After dealing with the origins of our population and the minglings of various racial stocks, the author outlines the variations in the physical appearance of the inhabitants of different English counties.

"There is no doubt," he says, "that in every part of England and Wales several types live side by side. Often, certain types are found only as rare exceptions, occurring in perhaps 1 per cent. of the population or less, but there are usually places where these, generally rarer, types occur in considerable numbers, perhaps making 20 or 30 per cent. of a sample. It is from evidence such as this that we are forced to gather our points as to the distribution of physical types in Britain."

As most of us know, the population of Northern and Eastern England is predominantly fair in colouring, and is characterised by its "long heads, straight profiles, fine noses, grey eyes, and fair hair." This is probably due chiefly to Scandinavian and Danish origins.

To cite a few examples. "The Yorkshireman of the north and east is not only generally fair and long-headed, but also tall and well built. . . . In remoter corners, however, especially towards Derbyshire, the darker types are much more numerous, though in the Derbyshire dales we again find numbers of the Beaker [1] type.

"In Cumberland and Lancashire fair long-heads are abundant enough, but the little dark long-head is also well marked in the latter. . . . Beddoe found the North of England and Derbyshire about the fairest region of the whole country. . . . Lincolnshire, again, is strikingly fair. . . . East Anglia has more constrasted types. . . .

"The Midlands obviously retain a larger element of the old stocks than do the north and east ; they were of old densely wooded and were cut off from East Anglia by great marshes. Beddoe was probably right in thinking that the Vale of Aylesbury and East Worcestershire, both areas of fertile land early occupied by Saxons, have a rural population fairer than the average of the Midlands. . . .

"In the south, Kent has tall, fair long-heads in large numbers, and so have Surrey, Sussex, and Hampshire ; but in the Romney Marsh, the Weald, and the north of the New Forest are pockets of darker types of older standing.

"As one goes west, either in the Midlands towards the Welsh border, or in the south towards the border of Wilts and Somerset or Dorset and Devon, the numbers of dark-haired people seem to increase, the older breeds become more conspicuous. . . .

"Devon appears to show much dark hair with grey eyes. . . . Cornwall has the darkest population in England, with dark long-heads thickly distributed, but also the stalwart dark broad-heads who are found in nearly all the fishing harbours."

AN AMPHIBIOUS TANK

A new type of military tank has caused much interest in the United States. Its "paces were tried out" not long ago before officers of the War and Navy Departments, and members of the American Society of Mechanical Engineers.

"The tank," says the *Scientific American* for February, "was driven on the level road at a speed of 25 miles an hour ; climbed a slope of 40 degrees at the foot of the Palisades of the Hudson. Returning to the bank, it moved down into the water, and, against a strong tide, crossed the river where it is nearly two miles in width, under its own power."

Its body consists of a plate-steel watertight structure. For road work it "runs upon solid rubber-tyred wheels. At the rear end of the tank is an extra pair of wheels

[1] So-called on account of apparent descent from immigrants who came into Britain from across the North Sea towards the close of the later Stone Age, and whose graves can be identified to-day by the presence of the so-called "Beaker" pot—a feature of the culture that they brought with them into Britain.

which, when the tank is running on the road, are sufficiently raised to clear the surface."

For cross-country work this remarkable vehicle is equipped with caterpillar chains, and for crossing water two propellers are "attached to the shafts which project from the rear of the under-water body, power being obtained from the motor."

PSYCHO-ANALYSIS AND M. COUÉ

"In the early stages of psychological medicine the chief stress was laid on suggestion, of which hypnotism was the most striking form. Faith and suggestion are still the prominent agencies in most lines of psycho-therapeutical treatment. It is altogether to them that are due any beneficial results which may have come from the sensational methods of Coué, of which so much has been recently heard, and those processes form the basis of much of the treatment methods practised to-day. It is now one feature of these two processes and of methods founded upon them that they make no attempt to reach the root of the disorder, in the treatment of which they are applied ; but their advocates are content to treat the outward and obvious manifestations usually called symptoms.

"When M. Coué tells his devotees to say that their pains are growing less and their appetite greater every day, he makes no attempt to discover the causal factors upon which the pains or the diminished appetite depend. Using the language of ordinary medicine, the treatment is purely palliative. The main principle of modern medicine is that, if symptoms only are treated while the cause of the symptoms is left untouched, the trouble will probably recur sooner or later, perhaps even in far more troublesome guise than that for which the palliative remedies were originally applied. The second main line of treatment is that which recognises this principle and makes it its chief business to discover the nature of disorder, one often dating back for many years, through whose activity the symptoms are produced. Its object is that the sufferer shall come to understand the faulty trends by which his disorder has been produced, and by such self-knowledge shall see where his life has left the normal path and how his steps can again be set upon the path of health. It is this process which is denoted when the physician speaks of the process of re-education."—The late Dr. W. H. R. Rivers in "An Address on Education and Mental Hygiene" included in his recently published book, *Psychology and Politics*. (Kegan Paul, 12*s*. 6*d*.)

A REMARKABLE ATMOSPHERIC PHENOMENON AT SEA

The January number of *The Geographical Journal* contains a problem-raising note on a letter written to the Editor by Dr. A. Birnham-Smith describing a phenomenon witnessed by the latter and other persons on board the s.s. *Eden Hall* in the Persian Gulf fifteen years ago.

"It was dark at the time, with a very glassy sea, when it suddenly appeared as if someone was turning flashlights on the ship (which was not provided with electric light). It turned out to be waves of light wheeling round the ship in the air just over the sea, and not actually on the surface. The phenomenon was observed for twenty minutes by all on board. Although, as we have said, the appearance seems to be an unusual one, a very similar phenomenon was reported in 1909 by the master of the Danish East Asiatic Company's steamer *Bintang*, Captain Gabe, as seen in June of that year during the passage through Malacca Strait, and a printed description was afterwards issued by the Danish Meteorological Institute, with an illustration. In this case the phenomenon is said to have resembled a revolving light, with a pretty fast rotation, the light-waves taking the form of long arms issuing from a centre which seemed to lie on the horizon. Inquiries instituted with a view to learning whether other observations of such a phenomenon existed at first met with negative replies, but eventually the report of a similar experience was obtained through the Dutch Meteorological Institute from Captain Breyer of the Dutch steamer *Valentijn*, who in 1910 observed the phenomenon near the Natuna Islands in the South China Sea."

New Methods of Judging Musical Ability

By Robert H. Thouless, M.A.

Fellow of Corpus Christi College, Cambridge; Lecturer in Psychology in the University of Manchester

CAN psychological investigation throw any light on the nature of the musical mind, on the problem of what makes up the difference between the musical person and the person who, in spite of all his efforts, remains incapable of musical performance and appreciation ? This is a problem which has been attacked by Professor Seashore, of the University of Iowa. His results have interest both for the teacher of music and for the student of psychology.

The method of dealing with such a problem as this is, first, to analyse the complex function of musical talent into simpler elements ; secondly, to devise methods of testing separately the ability of different individuals in each of these simpler functions. We ask, for example, why one person learns to play and

sing easily, while another seems incapable of learning to do either. It may be because the second person is incapable of discriminating between small differences in pitch, that is, degree of acuteness of tone, or he may be unable to remember music, although he hears it as accurately as the other, or he may be unable to sing because he cannot control the tension of his vocal chords. These—power of pitch discrimination, tonal memory, and control of the pitch of the voice—are examples of the simpler elements into which musical ability may be analysed.

Elements of Musical Talent

Professor Seashore repudiates the idea of the existence of any one "musical faculty," and analyses musical talent into twenty-five such simple elements. These are the following :

I. Musical sensitivity.
  A. Simple forms of impression.
    1. Sense of pitch.
    2. Sense of intensity.
    3. Sense of time.
    4. Sense of extensity.
  B. Complex forms of appreciation.
    1. Sense of rhythm.
    2. Sense of timbre.
    3. Sense of consonance.
    4. Sense of volume.

II. Musical action.
  Natural capacity for skill in accurate and musically expressive production of tones (vocal, instrumental, or both) in :
    1. Control of pitch.
    2. Control of intensity.
    3. Control of time.
    4. Control of rhythm.
    5. Control of timbre.
    6. Control of volume.

III. Musical memory and imagination.
    1. Auditory imagery.
    2. Motor imagery.
    3. Creative imagination.
    4. Memory span.
    5. Learning power.

IV. Musical intellect.
    1. Musical free association.
    2. Musical power of reflection
    3. General intelligence.

V. Musical feeling.
    1. Musical taste.
    2. Emotional reaction to music.
    3. Emotional self-expression in music.

Six of these investigations are of particular practical interest, since they can be repeated without special apparatus. These are the tests for : *sense of pitch, sense of intensity, sense of time, sense of consonance, musical memory*, and *musical imagery*. The first five of these are supplied on gramophone records. Full instructions as to Professor Seashore's method of carrying out the last are to be found in Chapter XI of his monograph.[1] By the use of these tests in schools, it is claimed that the teacher is enabled to detect those of his pupils who are deficient in the simple qualities which make up musical talent, and also to distinguish those especially gifted ones who may develop exceptional musical ability if they are given separate training.

The method of representing the performance of any individual in a given test is by his percentile rank, i.e. by his probable position in a group of a hundred unselected persons whose order is that of their proficiency in the ability tested. For example, a person who has 50 per cent. right in the pitch discrimination test will have a percentile rank of 0,[2] a person with 100 per cent. right will clearly rank as 100. The percentile ranks of persons who have between 50 per cent. and 100 per cent. right answers is given by tables based on the results of a large number of previous applications of the test. A person with 90 per cent. right is found to stand eighty-sixth in his power of pitch discrimination in a chance group of a hundred ; with 60 per cent. right he would stand only third from the bottom.

How to Test a Person's Sense of Pitch

Limitations of space make it impossible to discuss all twenty-five of the researches into these elementary capacities, so I will be content to describe in detail one only—the investigation of the sense of pitch. The pitch of a musical note depends on the number of vibrations per second of the sound waves producing it, the higher notes being produced by the sound waves with a large number of vibrations per second. The problem, therefore, is to discover by how many vibrations per second a given note must be altered before the person who is being tested can distinguish between them. For this purpose, a standard tuning-fork and one differing slightly from it in pitch were sounded in quick succession, and the subject was required to state whether the second tone was higher or lower than the first. Different intervals of time between the two forks were used, and an individual's power of discrimination between two tones was taken to be the interval of time between the standard and variable

[1] Referred to in note at end of present article.

[2] Because 50 per cent. is the number he would have right if his answers were determined by chance alone, i.e. if he had no power at all of determining which of the two notes sounded was the higher.

fork for which he gave 75 per cent. right answers. Very great individual differences were found; one person could perceive a difference of a quarter of a vibration per second, while another could only distinguish two notes in the same position in the scale if their pitch difference was fifty vibrations per second. Thus in this capacity the best person tested was two hundred times better than the worst—a remarkably wide range.

An Untrainable Faculty

The importance of this ability to discriminate pitches, both for the performance and for the appreciation of music, can hardly be questioned. It is therefore not surprising to find that in an examination of members of the Royal Opera in Vienna by Stücker, a very fine power of pitch discrimination was discovered, ranging from ·1 to 1·1 vibration per second for the A above middle C.[1] The question, however, which immediately raises itself in the mind is whether this finer pitch discrimination in musicians and singers is due to their training or whether it is inborn. In other words, has a man fine pitch discrimination because he is a practised musician, or has he become a musician (partly, at least) because he had a fine power of pitch discrimination from the first. If the former alternative were true, the measure of pitch discrimination would reveal musical training and not musical talent. From evidence drawn from a variety of sources, Professor Seashore concludes that the ability to discriminate pitch is innate, and is not affected by training. No material difference is found in the pitch discrimination record of a pupil after he has entered on a musical training, although such observations have been made for several years. Nor does this power increase with age. A group of children show the same distribution of the capacity as their parents.

While sensitive pitch discrimination seems to go hand in hand with spontaneous evidence of musical interest in children, it seems to be practically unrelated to the tendency to give them musical training. In other words, a child with a finely discriminating ear is no more likely to receive musical training than a more ordinary child. This may not be altogether wrong for two reasons. First, it must be noticed that pitch discrimination is not the only factor which makes up musical talent, and all the other factors must be taken into account in deciding what children are suitable for musical training. Secondly, although high musical achievement probably necessitates fine pitch discrimination, something less even than the normal fineness of discrimination is enough for most of the purposes for which musical education is ordinarily acquired. The fact that he can never be a first-class singer does not mean that a child will gain no benefit from an education in music.

Other Tests

The other investigations followed similar lines, with such differences of experimental method as their different problems required. For testing the sense of intensity, two notes were sounded successively, and the subject was required to say which was the louder. Similarly, for the sense of time, three successive taps were made, and the subject was required to state whether the interval between the second and third was equal to, greater than, or less than, that between the first and second. In the test for sense of consonance (sounding of two notes in harmony) two chords were sounded successively, and the subject was required to give a purely æsthetic judgment of which of them appeared to him to be the more pleasing. The musical memory test is a more elaborate one. A series of notes ranging in length from two to six is sounded twice, one note being altered for the second time of sounding. The subject is required to say which note is different in the second sounding. This test appears ridiculously easy to a person with fairly good musical memory, but other persons find it difficult or impossible to detect the note altered in the longer series. The investigation of auditory and motor imagery follows the general lines of Galton's famous *questionnaire*,[2] but it is more detailed. It is, I think, open to the criticism that in giving six degrees of vividness of images of all kinds it introduces a false appearance of exactness. Other more objective tests of imagery have been discovered since Galton's time, but these are less easy to apply.

The value of such an analysis can be tested by the musical ability which the individual shows in other ways. Such a correlation has been shown by Professor Seashore to exist. He gives as examples three cases taken from a collection of 308 university students. Mr. White ranked between 90 and 100 in sense of pitch and consonance, keenness of hearing, memory, singing key, and register of voice, and his worst record—in motility (capability of motion)—was over 60. Although he had had little formal training, he showed great interest and activity in music, and was emotionally responsive to it. Mr. Black ranked 10 or less in such important factors as sense of pitch, time, and consonance, and also in auditory imagery, so although he was better in relatively unimportant factors, such as sense of intensity, he might reasonably have been expected to be decidedly inferior in musical talent. This was the case. He had taken music lessons, but met with failure, and had little interest in music.

[1] Professor Seashore, however, throws doubt on the lowest of these figures.

[2] *Inquiries into Human Faculty*, by F. Galton. Appendix E.

Mr. Gray, who ranked well above the average in some factors (sense of pitch and keenness of hearing), and well below in others (sense of intensity, sense of time, and sense of consonance), had average musical ability. With little musical education, he possessed an artistic type of mind and lived much in musical feeling.

Value of These Investigations

It may be urged in objection to this kind of investigation that the possession of all the simple functions described—sense of pitch, sense of time, etc.—does not in itself make a musician. Something more than these must be supposed to be necessary to make up the difference between a Pachmann and a merely mechanically accurate performer, and this something may elude psychological analysis. This is probably true. We could not even give an account of what makes a champion tennis player, apart from such physical qualities as strength of wrist and arm, accuracy of co-ordination of hand and eye, etc. Two players may be equal in all these respects, and while one remains a good, but not very good, match player, the other may become English champion. What makes the analysis and investigation of these simple factors in musical ability much more important than the corresponding physical measurements of tennis players is their more elusive character. No one is likely to start training as a tennis player if he is blind, or club-footed, or has lost the use of his right hand. Yet a precisely similar error is constantly being made when money and time are wasted in giving children musical training who are totally deficient in one of the unitary factors which are necessary for any musical success at all, such as the sense of pitch or the possession of auditory imagery. If blindness and club feet were defects not immediately apparent on inspection, we would have reason to be grateful to anyone who discovered a way by which these defects could be detected otherwise than by the wasteful process of teaching tennis to all children and only discovering that they were blind or lame by the failure of prolonged attempts to teach them the game.

Dr. Seashore has, however, done more than this. His analysis of the factors which make up musical talent is in itself a great advance in the theory of musical ability. His list of twenty-five factors is a welcome recognition of the complexity of a condition which is simply explained in popular speech by the phrase : " He has no ear "—a phrase which assumes that the only difference between the musical and the unmusical person is that the latter is deficient in his power of discriminating pitches. How untrue this is can be proved by anyone who cares to experiment on the subject. I have myself found in a single test one person of exceptionally high and one person of exceptionally low musical ability, who showed exactly the same rating as each other in pitch discrimination.

Can the More Elusive Factors in Musical Talent be Analysed ?

The presence in musical talent of factors which so far elude psychological analysis is indicated by the complex character of the later functions investigated by Professor Seashore. Musical taste is not an elementary function like pitch discrimination. Perhaps it is one which may be further analysed, even although it may be impossible to split it up into really simple constituents. Such further analysis belongs to a branch of experimental psychology which may be called experimental æsthetics.

As an example of the investigation of these more elusive factors in musical talent, I will mention shortly some experiments performed by Dr. C. S. Myers on individual differences in listening to music. He used fifteen subjects of various degrees of musical appreciation, and obtained from them introspective reports of their impressions and mental attitudes while they were listening to music produced by means of a gramophone. It is impossible to give even a short summary of the results of such work as this. These investigations have been mentioned here only to illustrate the fact that experimental inquiry need not stop at the investigation of simple functions, although as it approaches more complex problems it must adapt its methods to their requirements.

READING RECOMMENDED

The Psychology of Musical Talent. By Professor C. E. Seashore. (Silver, Burdett & Co., Boston, 1919.)

Individual Differences in Listening to Music. By Dr. C. S. Myers. (*British Journal of Psychology*, General Section, July 19-2, Cambridge University Press, 9s.)

Substances Existing in Various Forms

By A. J. Berry, M.A.

Fellow of Downing College, Cambridge

Everyone is familiar with the fact that substances are, in general, capable of existence in more than one form. For example, the substance known as water may exist as ice, liquid water, or steam. We have thus become accustomed to classify the various states of aggregation of matter—that is, the different ways in which units of matter may be grouped together—as the solid, the liquid, and the gaseous states. This classification is, however, incomplete. There is usually

more than one variety of the solid form of a substance, and cases are also known in which varieties occur in the liquid and gaseous states.

Newton observed the high specific gravity and the power of refracting rays of light which the diamond possessed, and ventured the opinion that it would prove to be combustible. Inconclusive experiments on the subject were made by the older chemists, but the true nature of diamonds was first discovered by Lavoisier, a French chemist, who burnt them in oxygen, and found they yielded carbon dioxide—the same product as is obtained by the burning of charcoal. A few years later it was found that graphite—the substance from which pencils are made—when heated strongly with nitre, was also transformed into carbon dioxide. Diamond, charcoal, and graphite are therefore varieties of carbon, and are termed "allotropes."

Allotropy may be defined as the phenomenon of the existence of elements in more than one modification. However, not only elements, but also compounds containing two or more elements, show a similar disposition to exist in a variety of forms. Calcium carbonate, for example, occurs in nature as two completely different crystals, known respectively as Iceland spar and aragonite. The term "Polymorphism" had been employed to characterise this property of variation in the form of crystals of a compound, and implies a property in compounds similar to that which we have described in the case of the element carbon.

It has been known for many years that a variety of oxygen can be obtained by the action of electric discharges on the gas, which is endowed with much greater chemical activity than ordinary oxygen. This active variety of the gas is termed ozone. Ozone differs from oxygen as regards the number of atoms associated together to form a unit or molecule. The molecule of oxygen consists of two atoms only, but that of ozone contains three, and the greater energy associated with the ozone molecule accounts for the striking difference in its properties. An active variety of nitrogen, very different in properties from ordinary nitrogen, was prepared by Strutt about twelve years ago. This active modification, which can be obtained by subjecting ordinary nitrogen to the action of electric discharges at low pressures, presents even more striking contrasts, as regards chemical activity, with ordinary nitrogen than exist between ozone and ordinary oxygen. Ordinary gaseous nitrogen is an extremely stable substance, requiring fairly high temperatures to undergo interaction with other substances. This great inactivity has been associated with the remarkable stability of the two atoms of nitrogen which constitute the molecule of the gas. The nature of the molecule of active nitrogen is uncertain; it may perhaps consist of a single atom; in any case it must be different from that of ordinary nitrogen.

Results of Changes in Molecular Complexity

We must imagine the molecule of a gas the least quantity of a gas which can preserve the individuality characteristic of the whole—as an association of elementary atoms in a certain definite proportion. For instance, di-nitrogen tetroxide consists of two atoms of nitrogen associated with four atoms of oxygen to form one unit or molecule of the gas. Now by raising or lowering the temperature of this gas, we can make it break up into two equal units of nitric peroxide, each consisting of one atom of nitrogen and two atoms of oxygen, or to unite again to form the original unit. This change is associated with a remarkable change from the colourless di-nitrogen tetroxide to the dark-brown nitric peroxide. Similarly the unit of iodine up to a temperature of 700° is composed of two atoms of the element; above that temperature the fine violet colour gradually changes as the vapour dissociates into units of one atom, the change being complete at about 1,700°. We see in these cases that a variation in the number of identical atoms associated together in a molecule—which we can refer to briefly as a change in molecular complexity—is associated with remarkable changes in the properties of the substances concerned.

It has been considered legitimate to conclude that the differences in properties of the solid and liquid varieties of substances are also due to differences in molecular complexity, since all well-investigated cases which occur among gases can be explained in this way. Our knowledge of the liquid and solid states of aggregation is, however, very much less advanced than that of the gaseous state. When, therefore, we say that red and white phosphorus differ as regards their molecular condition, we do not specify to what extent they differ; all that we mean is that the remarkable difference in chemical reactivity exhibited by these two varieties of phosphorus must receive an explanation similar to that which accounts for the behaviour of the varieties of substances which are met with in the gaseous state. The crystalline condition of matter is, however, receiving much attention at the present time by the method of X-ray analysis developed by the Braggs during the last few years, and results obtained by this method upon polymorphic substances will be awaited with great interest.

The Transition Point

The temperature at which the solid and liquid phases of a pure substance coexist in stable equilibrium is termed the melting point. In the case of many polymorphic substances (substances existing in more

than one form) there is a similar temperature, termed the transition point. Thus in the case of sulphur, at temperatures below 96° the stable modification is rhombic sulphur; at temperatures above 96°, the stable phase is a different crystalline variety known as monoclinic sulphur. Each of these varieties possesses its own melting point, that of rhombic sulphur being 114·5°, and that of the monoclinic variety being 120°. The transformation of either form into the other is a reversible process at the transition point, just as the transformation of ice into liquid water and *vice versa* is a reversible process. The analogy between a melting point and a transition point is, therefore, remarkably close. There is, however, one important point of difference between them. It is possible to cool a liquid a few degrees below its freezing point without solidification taking place, the liquid being then in what is termed a metastable condition. On the other hand, no one has ever succeeded in heating a solid above its melting point. When we study polymorphic substances, we find that the transition point is, in general, very easily overstepped in both directions, because the rate of transformation of one form into the other is not great. It is for this reason that it is possible to determine the melting point of rhombic sulphur. If the substance is heated fairly quickly, the transition point (96°) is overstepped, and the melting point (114·5°) realised.

An interesting example of a substance which is polymorphic is to be found in the case of tin. As usually met with, this metal is a white crystalline solid. When exposed for long periods of time at somewhat low temperatures, the metal loses its familiar white crystalline appearance, and crumbles to a grey powder. Objects made of this metal, such as old coins or organ pipes in old churches, frequently show signs of what would appear to be corrosion, but what is really transformation of ordinary white tin into the grey variety which is the stable modification at temperatures below 18°. Actually, all tin, except in warm summer weather, is in the metastable condition, but as the transformation into the stable grey powder is so sluggish, objects made of this metal can be preserved for long periods.

Reversibility of Transformation

Substances such as sulphur and tin, whose behaviour is such that the transformation of one form into the other is a reversible process at the transition point, are termed enantiotropic. There is another class of substances which differs from these, in that one form is always less stable than the other; the transformation of that form into the other proceeds in one direction only. Phosphorus is an example of this class of substances. The two best-known forms of phosphorus are the white and the red varieties. Now white phosphorus is always metastable with respect to red. If sticks of white phosphorus are stored in a bottle containing water and exposed to light for long periods, patches of the red variety gradually make their appearance. There is only one way of transforming red phosphorus into the white form, and that is by vaporising the substance and quickly cooling the vapour. When a solid substance is produced from a liquid or vapour it does not, in general, assume the most stable configuration all at once, but first takes up an unstable one, which may remain for a long time before the most stable form is reached. It is in this way that substances such as white phosphorus can be prepared. Substances of this kind are termed monotropic. In the case of enantiotropic substances the transition point lies between the melting point of the two forms; in the case of monotropic substances it is probable that the melting points of both forms are below the transition point.

In the case of both classes of polymorphic substances, the less stable form has always the greater vapour pressure and the greater solubility. This general phenomenon has been found experimentally, but it is only what would necessarily be expected on theoretical grounds. It is not always an easy matter to decide whether two specimens of a substance, which appear to differ in some property, are truly polymorphic. The experimental difficulties of determining the existence or otherwise of a transition point are frequently very considerable. An interesting example is to be found in the case of mercuric oxide. This substance can be obtained in either a yellow or red form, depending upon the method of preparation. Determinations of solubility carried out by electric measurements appear to indicate a slight but distinct difference between the two forms. On this ground, some have concluded that mercuric oxide is polymorphic. Ostwald has, however, pointed out that the solubility determinations do not admit of any conclusion being drawn. It is well known that the solubility of sparingly soluble substances depends upon the size of the particles, that of very small particles being greater than that of larger ones; just as the vapour pressure of small drops is greater than that of larger ones, as was pointed out by Lord Kelvin many years ago. The difference between yellow and red mercuric oxide may be entirely due to the difference in size of the particles.

The Liquid State of Aggregation

The investigation of the liquid state of aggregation from the point of view of polymorphism has yielded many results of interest. Certain organic compounds when heated melt sharply at definite temperatures to

milky liquids, and on being further heated these milky liquids become clear at definite temperatures. When these liquids are cooled, the phenomena are reversed. In addition to their turbid appearance, these milky liquids exhibit strong double refraction, and the term "crystalline liquids" has been applied to them. Much discussion has taken place with reference to the justifiability of this term. Greater interest, perhaps, is attached to liquid sulphur. When sulphur is melted, it fuses to an amber-coloured liquid, but on being further heated, it becomes much darker and more viscous. It has been shown that this phenomenon is due to the fact that liquid sulphur is not a single substance, but a mixture of two different liquids in dynamic equilibrium. The proportion of these two liquid forms varies with the temperature. Smits, who has given much attention to the theoretical aspects of polymorphism, considers that the case of liquid sulphur is to be regarded as one of dynamic allotropy, an idea similar to that of dynamic isomerism (reversible isomeric change), familiar to organic chemists.

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How Upper Winds are Measured

By C. E. Britton, B.Sc.

It is a matter of common observation that clouds often proceed from a different quarter from the wind at the ground, and in most cases appear to be carried along at much greater speed than that of smoke from chimneys. In other words, the speed and direction of the wind in the upper air is often different from the speed and direction of the surface wind. In fact it is very unusual to find the wind at a point 10,000 feet above the ground to be the same, either in direction or speed, as the wind experienced at the same instant on the surface.

Recent Causes effecting Upper Air Investigations

Although this difference in the wind at various heights in the atmosphere has been known for a long time, it is practically only within the last twenty-five years that the velocity of these upper winds has been scientifically measured. At first, upper air investigations were only undertaken by research workers, but, as the importance of the aeroplane came into prominence, measurements of upper winds began to be made at flying schools. It was the Great War, however, which made the continuous and extended observation of the upper atmosphere both necessary and possible. Requests for upper wind readings came from many and various directions. The rapidly increasing bands of aviators required the information; the artilleryman wanted it to ensure accuracy in his firing; the gas warfare departments were equally interested, and it was of the first importance to the sound-rangers. These represented but a few sections of the forces who found of the greatest use the information gleaned by the meteorologists. As a result of this unparalleled expansion, there is now a network of stations in this country where observations of upper winds are made three or four times daily, and the results are embodied by the Air Ministry in a special "Upper Air Supplement of the Daily Weather Report."

Usual Procedure of Investigation

The method of upper wind measurement in general use consists essentially in releasing a small rubber balloon filled with hydrogen and following its subsequent journey by means of a special instrument to measure angles, known as a theodolite. There are several types of balloon used for the purpose, but the one in most common use is made of very thin sheet rubber weighing just over an ounce; it is inflated with hydrogen until its diameter is about 2 feet. The rate of ascent of such balloons in still air has been found to be very nearly uniform, and J. S. Dines [1] has given an empirical formula connecting the rate of ascent with the weight of the balloon and the mass it will just lift when inflated. For the type of balloon mentioned above a velocity of ascent of about 500 feet per minute is obtained, and the usual practice is to adjust the amount of gas put into the balloon so that its rate of ascent, on the basis of the formula, shall be exactly 500 feet per minute.

The flight of these balloons (pilot balloons, as they are called) is watched by an observer through a theodolite designed for this special purpose. These instruments are so designed that the observer is always looking in a horizontal direction, however much the balloon may move about in the sky, and the tangent screws moving the telescope are constructed so that rapid motion can be secured to keep the balloon in the field of view.

The first step in the process of making an observation consists in the setting up of the theodolite. After levelling the instrument, the telescope is sighted upon a prominent object in the landscape, the bearing of which is known, and the scale is revolved until a fixed

[1] *Q.J.R. Met. Soc.*, 1913 and 1918.

mark records the proper direction of the object. The scale is then clamped into position and the instrument is ready to be used for observation.

The second operation is to inflate the balloon. The balloon is weighed and, from the Dines formula, the weight it should just lift, so that the rate of ascent may be 500 feet per minute, is calculated. The balloon is accordingly filled with pure hydrogen from a cylinder of the compressed gas until it just lifts the calculated weight. The orifice in the balloon is sealed and all is ready for the flight.

Generally two observers work together in taking an observation, and, all being ready, one of them releases the balloon and at the same time starts a stop watch. The other sights the balloon in the telescope of the theodolite and follows its motion by moving the two tangent screws in appropriate directions. Exactly at the end of successive minutes the first observer reads the scales of the instrument, and the observation is continued until the balloon is lost to sight. This may occur from many causes. The balloon may enter cloud or haze, or it may burst or be lost in distance. Should the observation terminate by the balloon entering cloud, the height of the cloud becomes very accurately known.

As a result of the observation, the position of the balloon at the end of each minute is known. From these figures it is easy to compute the speed and direction of the wind in each minute and, further, as each successive minute represents an additional 500 feet in altitude, the heights at which the various winds occur are also known. In this way upper winds can be measured up to as great a height as a pilot balloon can be followed through the theodolite. On a clear day, if the wind be not too strong, heights of 40,000 feet are by no means impossible. The necessary calculations can be effected most readily on a special slide rule made by the Air Ministry, and when the balloon is finally lost, the whole of the results are instantly available for use.

A More Accurate Method for Special Uses

It will be at once appreciated that the accuracy of the method is primarily dependent on the uniformity of the rate of ascent of the pilot balloon. Should this depart widely from the theoretical value of 500 feet per minute, the results obtained will be vitiated. On most days the movement of the atmosphere in a vertical direction is small and the error introduced by assuming a steady rise of the balloon is negligible from a practical point of view. For certain investigations, however, it is necessary that uncertainties due to variations in the rate of ascent should be avoided. Thus in experimental gunnery it is important that absolutely accurate values of upper winds should be available. So also in investigating the structure of the atmosphere at great heights; here the balloon has expanded so much owing to the decreased external pressure that porosity or pin-holes develop and the rate of ascent ceases to be 500 feet per minute. Cases are by no means rare in which the balloon starts to fall, so that calculations based on a uniform rate of ascent will be grossly misleading. To obviate the difficulty, the balloon is followed by two theodolites, one at each end of a measured base line.

The sets of figures thus obtained at the intervals of a minute enable the position of the balloon in space to be fixed, and no assumption as to the rate of ascent has to be made. The method, though of greater accuracy than when only a single theodolite is used, nevertheless demands more personnel, more equipment, and good telephone communication. The amount of computing is also much greater, and the results are not therefore available so quickly. For these reasons this method is not in general use.

A War-time Method

If the speed and direction of the wind at, say, 20,000 feet are required, it will be noted that it would take a pilot balloon 40 minutes to attain this height, provided it did not burst in the meantime. Occasionally, especially during the war, such a wind value was required very quickly, and an ingenious method of effecting this was invented. It consisted in firing a round of anti-aircraft shell with fuse set to burst the shell at the desired height. A puff of smoke was thus produced which was carried along by the wind prevailing at that height. The reflection of this smoke-burst was observed in a horizontal mirror, the observer looking through a fixed peep-sight at a known height above the mirror. The procedure was to make a dot on the mirror where the reflection appeared to be, and then to make a similar dot, say sixty seconds later, in the new position of the burst. The line joining these two dots was thus the path of the reflection as seen in the mirror. Simple mathematics obtain the result that the length between the dots bears the same proportion to the height of the peep-sight above the mirror as the actual distance covered by the smoke burst bears to the height of the burst. As three out of the four terms of this proportion are measurable, the unknown term, namely, the distance travelled by the smoke, becomes immediately calculable. As this distance was covered in sixty seconds, the speed of the wind follows very simply. The wind direction is readily obtained by suitably orienting the mirror.

Should the day be persistently overcast with low cloud, all the foregoing methods are of very little use. Recourse must then be had to very special methods which it is not proposed to deal with in the present

article. What has been said will be sufficient to give the reader an insight into the methods which are used to give the values of the upper winds to be found in the reports and forecasts in the daily Press.

Sunspots and Climate

Recent discoveries in climatology, in astronomical physics, in geology, and in archæology have been collected together in an amazingly interesting book [1] and utilised to give an explanation of the cause of climatic changes both in geological and in historical time. The book contains information of many kinds, carefully sifted and admirably set forth, in addition to the authors' fertile theories and their deductions therefrom. It illustrates very well the resource, the insight, and the ingenuity of the human mind in face of a difficult problem.

Climatic change in the past has been always an interesting subject. Less than thirty thousand years ago most of our country was under a sheet of ice. At another time its climate was even more genial than that at present. To-day most of Greenland is under ice; it is hard to believe that once coral reefs fringed its shores and palm trees grew on its lands. At one time indeed the climate of the earth seems to have been so equable that many plants and animals could live 1,500 and at other times even 4,000 miles farther from the Equator than now. Changes in wetness have also been great. There are to-day deserts in Asia, even now a feat to cross, which were once so fertile as to support tribes and even contain cities. Nor are these changes confined to the remote past. In the fourteenth century A.D., for instance, it was possible once or twice to cross the Baltic from Germany to Sweden on the ice.

The explanation of these changes and others, less striking but no less interesting, is a very difficult matter. Some, of course, present less difficulty than others. Day-to-day variations of weather are easily explained, and nobody needs to be told more than once why summer is warmer on the average than winter. But why are certain areas every eleven or twelve years subjected to abnormally disturbed weather? Why is something of a similar kind said to occur every thirty-three years? What is at the bottom of the so-called historical pulsations? For example, the twelfth or thirteenth century before Christ was very dry, so were the seventh and the thirteenth of our era if the thickness of the annual rings of the large trees in California and Arizona affords a reliable indication of the amount of moisture available during the period of growth. The fourteenth century A.D., on the other hand, was a time of great climatic severity in many parts of both the Old and the New Worlds which ordinarily have mild climates.

[1] *Climatic Changes. Their Nature and Causes.* By Ellsworth Huntington and Stephen Sargent Visher. (London: Humphrey Milford; New Haven: Yale University Press, 17*s.* 6*d.*)

Much more difficult to give is an explanation of the Ice Age. About 30,000 years ago the Ice Age was at its height in our own country, in parts of North America, but not in corresponding parts of Asia. Why do ice ages occur, and why do they occur, as they appear to do, at irregular intervals? All these and cognate problems are very carefuly stated by the authors of this book before they attempt to solve them. And they have a solution. But before giving it they describe and criticise the hypotheses of climatic change that have been put forward in the past. Each of these, they think, is of importance, but none is really the fundamental one. Variations in the position of the earth when it is nearest the sun, they believe, have a real though slight influence in causing cycles with a length of about 21,000 years. Changes in the amount of the gas carbon dioxide in the air probably have a more important but extremely slow influence on the climate over large periods of time. Variations in the size, shape, and height of the continents are constantly causing all manner of climatic complications. These, however, do not cause rapid fluctuations nor pulsations. The eruption of volcanic dust (which acts as a screen to the sun's rays) appears occasionally to lower the temperature, but it is probable that this cause is less important than many geologists have believed. There is finally the possibility that variation in the position of the poles might be a factor in climatic changes. This theory has been adduced in two main forms. First, the "pendulation" theory, which supposes that the earth's poles swing very slowly backwards and forwards about an axis joining a point in Ecuador with one in Sumatra. Varying distances from the pole, of course, cause changes of climate, "and the movements of the ocean, which adjusts itself to the change of pole more rapidly than the land, causes the great transgressions and regressions of the sea and the elevation and subsidence of the land." Secondly, there is the theory of Wegener,[2] which explains the apparent variation in the position of the pole by the assumption that the earth's crust is moving slowly over the earth's core so that the axis, without necessarily changing its position, passes through different parts of the crust at different epochs.

A simpler and, they believe, a better explanation than any of these is the authors' sunspot hypothesis. This briefly put is as follows: The climate of the earth is regulated by the sun, and consequently varies in harmony with any disturbance in the amount of radiant energy the latter sends out. The times of these disturbances are known because they occur when spots on the sun are visible—a sunspot being a part of the sun's disk where more than the normal amount of energy is poured out. The consequence on the earth of spots on the sun is not, however, as might be imagined, a general rise in temperature. It is more complex than that. For the earth's temperature is conditioned not only by the energy it gets from the sun, but also by the energy it radiates into space. And it is possible, and does, as a fact, happen, that the

[2] For further information on this theory readers are referred to Professor Wegener's article on *The Origin of Continents and Oceans*, Discovery, vol. iii, No. 29.

extra outpouring of energy from sunspots so affects the earth's atmosphere as to make it stormier than usual, with the consequence that the earth's surface is actually cooled. In the past some of these disturbances in the sun have been large, and the earth consequently so affected by them that a glacial epoch has resulted ; at other times and more frequently the disturbances have been smaller, and parts of the earth, although profoundly affected, have suffered less. These have been the historical pulsations. More frequent still and of still less force have been the disturbances said to occur every thirty-three years and those more perfectly recognised as occurring every eleven or twelve.

It is the sunspots, the authors believe, which are the fundamental cause of the variations in the earth's climate. They bring about glacial periods, create oceans and mountain ranges, and indeed affect our whole physical environment. The arguments for this cannot be given here. Readers interested in them will find them in the book.

The next question to be asked is : "What causes the sunspots ?" That, indeed, is a difficult question. Astronomers declare they do not know But Dr. Huntington and his colleague put forward a very fertile hypothesis. They believe that sunspots—disturbances in the sun's atmosphere—are caused by the conjunction of the planets as well as by the less regular but vastly more disturbing influence of other stars which pass our solar system in their journey through space. It is obvious that changes in the energy emitted by the sun must be due either to a source in the sun or to a source external to it. If it be in the sun we are, so to speak, "done," because no one at the present time can formulate in precise terms a reason therefor ; but if the source be outside, we have the whole universe in which to seek a likely cause. Now Jupiter is the largest of the planets, and its changing position with respect to the sun might affect the latter's atmosphere in some way. This way is still open to question, but ignorance of it need not affect the matter. What is of significance is that Jupiter's period of revolution round the sun, 11·86 years, is very nearly that of the sunspot cycle. When, indeed, the effects of Jupiter, Saturn, and the other planets are combined they produce a highly variable curve which has an extraordinary resemblance to the sunspot curve. Because of this the authors accept this planetary hypothesis of sunspots and proceed to develop it. It is known that the climatic difference between sunspot maxima and minima, as measured by temperature, amounts to at least a twentieth and perhaps a tenth of the difference between the climate of the last glacial epoch and the present. From this the authors deduce that a body exerting only four times Jupiter's present tidal effect and placed at the average distance of Jupiter from the sun would so disturb the sun's atmosphere as to make possible a glacial period over the earth.

It is clear that what Jupiter and the other planets may do regularly in, so to speak, a humble way, may be done on a larger scale at irregular intervals by the stars most nearly encountered by the sun in its journey through space. The authors' theory is that a star may influence the sun so as to bring about climatic change on earth in proportion to its size, temperature, and nearness to the sun. The first two of these are fairly constant, but since stars and the sun are moving relatively to each other through space, the third varies. At most times the distances of stars, although variable, are so immense that it may be said the stars have no influence on the sun at all, but there have been times (they can be worked out from astronomical data) when the nearest have been sufficiently near to have, on certain assumptions, a much larger effect than the planets. These times the authors connect with the times of great climatic changes. They show that an average single star would influence the sun enough to cause glaciation on the earth if it came within two hundred thousand million miles of it. They show too that if α Centauri, the nearest fixed star to the sun and at present 4·4 light-years distant, came within 1·4 light-years it would produce a glacial epoch. From existing astronomical data the influence of the proximity of the stars to the sun on the climate of the earth can be worked out, and in Chapter XV a curve is given showing the climatic change of 140,000 years (from 68,000 B.C. to A.D. 72,000) so inferred. The curve shows that 70,000 years ago the climate was extremely mild. It gradually became severer, being 45,000 years ago approximately what it is to-day, and became severest about 28,000 years ago. (This agrees very well with the time of the last glacial epoch, which the best authorities put between 25,000 and 30,000 years ago.) The curve shows an amelioration of climate since that time, although it suggests that there is still considerable severity. If we look forward to the 70,000 years ahead we see from the curve that the climate will be, on the whole, very like that of to-day. In that time there will be no return to the very mild climate ; likewise there will be no glacial epoch.

These interesting speculations are being developed in a book shortly to be published entitled *Earth and Sun*.

A. S. Russell.

Reviews of Books

PROFESSOR BERGSON'S ATTACK ON INTELLECTUALISM

The Misuse of Mind. By Karin Stephen. With a prefatory letter by Henri Bergson. (Kegan Paul, 6*s*. 6*d*.)

The exposition of Professor Bergson's stimulating and disconcerting philosophy is a matter of peculiar difficulty, for he demands that we should put aside our old logical modes of thought and take up a new attitude towards reality, and since language itself was created by the old modes of thought that we are asked to abandon, it follows

that the new attitude finds itself at the outset without a vehicle of expression. The philosophy therefore appears at first to bristle with paradoxes, but these are resolved as the ideas behind them gradually become familiar and the difficulty of the philosophy is found to lie principally in the language in which it must of necessity be expressed.

Professor Bergson's theories are disconcerting because we are not much given to examining the shortcomings of our intellectual processes, being perhaps even a little complacent in the possession of a mental apparatus so much more complex and effective than that of our predecessors in evolution. But if, as we may assume, our mind has been evolved in order to enable us to act efficiently, it is not altogether surprising that we encounter certain difficulties when we apply it to another end—that of knowing for the sake of knowing.

It is perhaps an open question whether the difficulty that we experience in trying to get at the " real truth " of things is due to an inherent incapacity of the intellect, or whether, as Professor Bergson claims, it is due to a faulty habit of thinking; for he points out that we commonly use our mind not in order to know as much as possible, or even to know as accurately as possible, but in order to arrive at a working explanation of the situation with which we are presented. In order to explain the situation, all facts in it are not of equal value to us, but those facts stand out that serve to identify the situation with some previous experience, and enable us to describe it in terms of the already known; any facts that are superfluous to our explanation, or incongruous with it, are liable to be neglected or even unperceived, so that our anxiety to obtain a workable explanation of a situation is liable to limit rather than extend our knowledge of the facts themselves. We may even disregard the facts in favour of some more or less fallacious explanation of them, as when we speak of the " flow " of an electric " current " along a wire. The attitude of Professor Bergson and his followers towards reality may be compared with that of the physicist who is investigating the nature of electricity, and the attitude of the rest of the world towards reality may be compared with that of the electrical engineer who is content to think in terms of volts and ampères.

It has been the disappointing experience of some explorers that primitive races are occasionally less impressed with the unfamiliar mechanisms of our civilisation than one might have hoped. They fail to appreciate them because they are just a little too ready with an explanation, and a gramophone may be quite satisfactorily " accounted for " by them as a superior kind of ventriloquism. Our own attitude towards a new phenomenon is not so very different, and it will probably be admitted that even the most highly civilised individual, when presented with an unfamiliar situation, such as a spiritualistic séance, may be biased in his observation of the facts by the explanation that he applies to them. Professor Bergson holds that this habit of mind is followed not only with the unfamiliar, but also in our everyday " common-sense " attitude, in which we seek not to know the facts, but to construct from a limited selection of them a workable explanation. Thus, in spite of the Scotsman's famous definition of time as " an arbitrary division of the continuous," we are compelled to parcel it out into blocks of seconds, minutes, and hours, and divide it into past, present, and future in order to think of it in a useful way, and therefore we come to miss its real nature, its essential continuity.

This " explanatory " and analytical habit of mind works well enough in the ordinary business of life, but, according to Professor Bergson, it fails us when we employ it in the region of philosophic inquiry since it carries with it a conception of reality built up out of our fallacious explanations of fact and effectively barring any real progress towards the truth. To throw aside our old logical modes of thought requires an heroic mental effort, a kind of intellectual *salto mortale* that threatens to plunge us into the void if we fail to catch the precarious trapeze that Professor Bergson holds out to us and thereby " regain our contact with direct experience "; for we are asked to forgo all classification into mutually exclusive parts, and to treat such ideas as " singular " and " plural," and " past " and " present " as abstractions.

The form of this " direct experience," to which the new attitude of mind should lead us, is described by Professor Bergson as " duration," a process that underlies all change, fusing the elements that change into a synthetic continuum, and thus being in itself essentially creative.

It may be asked whether it is worth while for anyone who is not a professional philosopher to grapple with these difficulties. An answer to this question may be found on p. 99 of Mrs. Stephen's book, where the author says: " If we could overcome this bias [of our habitual mode of thought], we might know more than we do now, though how much more it is not possible, in advance, to predict." Such a promise goes far to explain the wideness of interest that has been evoked by Professor Bergson's philosophy, and contrasts with the faint suspicion of sterility that is attached to the academic philosophies. Even if the reader is unable to accept Professor Bergson's point of view, there is a strong stimulus in his searching criticism of our intellectual methods, of the methods which everyone, whether " plain man " or " intellectual," uses to gain fresh knowledge.

Although Mrs. Stephen's book carries the sub-title of " A Study of Bergson's Attack on Intellectualism," yet it is not the study of a purely destructive criticism, but actually an exposition of the fundamentals of Bergson's philosophy. It is admirably clear, and the author has avoided the technical terms that make most philosophical works so formidable to the average reader. It forms an excellent introduction to the constructive aspect and application of the philosophy, and is made authoritative by a foreword from Professor Bergson in which he says: " The author has been able to unify and present with great logical rigour views which I was obliged by my method of research to treat in isolation."

F. A. Hampton.

(*a*) *The Practical Applications of X-rays.* By G. W. C. Kaye, M.A., D.Sc. (Chapman & Hall, 10*s.* 6*d.*)

(*b*) *The Industrial Applications of X-rays.* By P. H. S. Kempton, B.Sc., A.R.C.Sc. (Sir Isaac Pitman & Sons, Ltd., 2*s.* 6*d.*)

(*a*) The first four chapters of Dr. Kaye's book contain a clear, an authoritative, and, in so far as the subject allows, a simple account of the nature, production, and measurement of X-rays. They summarise the existing knowledge on the theoretical side. The fifth chapter describes and illustrates the medical application of the rays, and the sixth their industrial application. How wonderfully the subject of X-rays has been developed in the past twenty-five years! A striking illustration of the advance in technique is shown in the frontispiece: a good radiograph of a hand made in 1896 after an exposure of twenty minutes is shown to compare ill with one made in 1921 with an exposure of one-hundredth of a second. Many of the photographs illustrate practical applications of the rays made by the author during the war years. All are excellent. Among the many radiographs shown are those illustrating defective welds in a steel plate, a foot inside a boot, thumb-prints, a crack in the piston of an aeroplane engine, grub holes, forbidden knots, and splices in aeroplane spars, and the "insides" of many objects like golf-balls, fuses, rifle-grenades, automatic pistols, and alarm clocks. The radiographic method is a terror in revealing defective work, poor materials, and fakes of all kinds. These and other applications are described in the text.

(*b*) Mr. Kempton's book is an introduction to the apparatus and methods used in the production and application of X-rays for the examination of materials and structures. It describes what has been done and what can be done with these rays. It is carefully compiled, always to the point, and suitably illustrated, although it has not the wealth and beauty of the illustrations of Dr. Kaye's book. Like most of Pitman's Technical Primers it is good value for the money.

A. S. R.

The Supremacy of Spirit. By C. A. Richardson, M.A. (Kegan Paul, 5*s.*)

This book is an exposition for general readers of the author's larger work on the same subject. After explaining what philosophy is, and discussing modern philosophies in a clear and interesting manner, he introduces his own views, which are founded on those of Leibniz. To quote Mr. Richardson: "Reality consisted (for Leibniz) in an infinite multitude of individuals, conceived of as unitary, indivisible forces or agents, psychic in nature, to whom he gave the name of 'Monads.'" A development of this point of view leads the author to speak later of the assimilation of food as the introduction of new monads into an organism, which are drilled into the part they have to play by monads already there.

Such a point of view is certainly a novel one to the mere physiologist. Moreover, the author's further comments on the suitability for food of organic substances, highly developed monads, and the unsuitability of inorganic substances, which are more lowly, show that he has not taken into account that inorganic substances play a part in the mechanism of life scarcely second to that of the highly developed "monads" such as boiled beef and cabbage.

The later chapters deal with Spiritualism; in fact the book is designed to lead to a scheme of philosophy in which spiritualism finds a place. It comes as a surprise to read of "Ectoplasm"—a substance which emanates from media in a state of trance, as if its existence in fact were as little disputed as the existence of platinum.

It is of the essence of a true philosophy that it should harmonise all the phenomena of nature. Mr. Richardson's scheme, however, goes even farther—it harmonises all the phenomena of this world and the next and a few which, at least in the opinion of many who have considered them, have no existence in either.

R. J. V. P.

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY AND ARCHÆOLOGY

The Races of England and Wales. By Prof. H. J. Fleure, D.Sc. (Benn Bros., Ltd., 5*s.*)

Egypt and the Old Testament. By Prof. T. Eric Peet, M.A. (Liverpool University Press, Ltd., and Hodder & Stoughton, Ltd., 5*s.*)

History of Roman Religion. By Prof. W. R. Halliday, B.A., B.Litt. (Liverpool University Press, Ltd., and Hodder & Stoughton, Ltd., 5*s.*)

Ancient Man in Britain. By Donald A. Mackenzie. With foreword by G. Elliot Smith, F.R.S. (Blackie & Son, Ltd., 12*s.* 6*d.*)

CLASSICAL LANGUAGES AND LITERATURE

The Making of Latin. By Prof. R. S. Conway, Litt.D., F.B.A., etc. (John Murray, 5*s.*)

The Claim of Antiquity, with an annotated list of books for those who know neither Latin nor Greek. Issued by the Councils of *The Societies for the Promotion of Hellenic and Roman Studies* and of the *Classical Association.* (Oxford University Press, 1*s.*)

Chanties in Greek and Latin. By W. H. D. Rouse. (Basil Blackwell, 2*s.* 6*d.*)

A Plain Guide to Greek Accentuation. 3rd Edition, revised.] By F. Darwin Smith, M.A. (Basil Blackwell, 3*s.*)

MISCELLANEOUS

The Book of Religion and Empire. A Semi-Official Defence and Exposition of Islam written by order

at the Court and with the assistance of the Caliph Muta-Wahkil. (A.D. 847–861.) By 'ALI TABARI. Translated by A. MINGANA, D.D. (Manchester University Press, Longmans, Green & Co., and Bernard Quaritch, Ltd., 10s. 6d.)

The Outline of History. By H. G. WELLS. The Definitive Edition. Revised and rearranged by the Author. (Cassell & Co., Ltd., 21s.)

PSYCHOLOGY

Conditions of Nervous Anxiety and their Treatment. By W. STEKEL. Authorised translation by ROSALIE GABLER. (Kegan Paul, Trench, Trübner & Co., Ltd., 25s.)

An Introduction to the Psychology of Religion. By ROBERT H. THOULESS, M.A. (Cambridge University Press, 7s. 6d.)

Psychology and Politics. By W. H. R. RIVERS, LL.D., F.R.S., etc. With Notes by G. ELLIOT SMITH, F.R.S., and C. S. MYERS, F.R.S. (Kegan Paul, Trench, Trübner & Co., Ltd., 12s. 6d.)

Conflict and Dream. By W. H. R. RIVERS, LL.D., F.R.S., etc. With Preface by G. ELLIOT SMITH, F.R.S. (Kegan Paul, Trench, Trübner & Co., Ltd., 12s. 6d.)

SCIENCE

On Certain Pathological Elements in Human Blood. By C. H. COLLINGS.

Glands in Health and Disease. By BENJAMIN HARROW, Ph.D. (George Routledge & Sons, Ltd., 8s. 6d.)

Biology for Beginners. By TRUMAN J. MOON. (George G. Harrap & Co., 6s.)

A very complete survey of Biology, up-to-date and fully illustrated. Although intended for schools, it will be welcomed by many whose interest in natural history is neither compulsory nor utilitarian. The price, when the scope, the numerous illustrations and the wide appeal of this carefully written book are considered, is surprisingly low. One feature, however, deserves comment. The author concludes with a terrible denunciation of alcohol and tobacco—"Tobacco decreases your personal attractiveness. The odour of breath, hands, and perspiration, the stains on fingers and teeth, do not add to your good looks." Tea "sometimes seems to soothe the nerves (which ought not to need soothing)." The book hails from America, and the picture of a biology class studying the tobacco craze calls up surmises of New York classical students at their tasks. Do they, we wonder, discuss chewing gum ?

A Textbook of Inorganic Chemistry. By G. S. NEWTH, F.I.C., F.C.S. (Longmans, Green & Co., 8s.)

A new and enlarged edition for 1923 of a long-established and much-used book.

Correspondence

THE DEGENERATION OF FUNCTIONLESS ORGANS

To the Editor of DISCOVERY

SIR,

I have been recently much interested in the phenomena of atrophy and degeneration. The subject is a very debatable one, but, although discussed at length in all works on heredity and evolution, I have never seen any reference to the explanation that I now put forward, and it is on that account that I hope you will find room for this letter in the pages of your excellent journal.

My attention was first attracted to the subject by the weakness of the unsatisfactory explanation to which all the authors on the subject seem to be forced. Take first the case of the abortive wings of certain species of birds which, throughout many generations, have ceased to fly. Most authors strive to explain this on the principles of Natural Selection, saying that those individuals, having an inborn smallness of wing, were able to develop greater leg power and thus tended to be preserved. So far so good, but, as Mr. Watson points out, "In certain cases such an explanation seems undeniably far-fetched. Take the case of the abortive eyes of cave-dwelling fishes." Here then the Natural Selection solution of the problem seems to break down and Mr. Watson, and indeed all other authors on the subject, are forced to the rather weak conclusion that "the inheritance of the effects of disuse is the obvious explanation, and any other must appear both less simple and less probable."

I say that this conclusion is weak because these same authors express disbelief in the uncertain and, indeed, almost certainly imaginary phenomenon of the inheritance of acquired characters. Yet this explanation necessitates a slight acknowledgment of the validity of the phenomenon, for eye-weakness produced by life in the dark is a character acquired after the body- and germ-plasms have become separate. Many biologists have tried to explain away this contradiction by saying that mutilations have only a slight effect on the general system and are not, therefore, inherited, but the effects of disuse burrow deeper and are likely to affect the germ-cells. This does not appear to me to be a solution, but rather an admission of failure to solve. In the first place, the truth of the statement is debatable; secondly, even if we assume it true, why should the disuse of an organ affect only that portion of the germ-plasm representing it, unless we resurrect a theory like the Pangenesis of Darwin—surely the most complicated and least probable theory ever propounded ?

None of these biologists seem to have looked for an explanation in the better-known and more certain process of Natural Selection. Why not ? They seem to regard Natural Selection as a process of elimination only; but why not also a process of retention ? To take the case of the fishes already mentioned. Fish living in the light are dependent on their sight for their safety; consequently Natural Selection has eliminated those individuals

having inborn blindness, thus producing a race with good modal eyesight. Now why should not a reverse process be the cause of partial or complete blindness amongst fishes living in darkness? Those fishes having inborn blindness were just as capable of survival as their comrades having perfect but useless eyes; consequently a process which we might call "Natural Retention" has retained the factor for blindness, and, by constant crossing, the mode of the race in the direction of eye perfection has been reduced. This theory will no doubt be attacked upon the ground that the process would be too slow, but critics in this direction must remember that blindness is a common aberration among animals whose eyes are so primitive in form as those of fishes, and that the factor for blindness would in all probability act as a Mendelian dominant. Also the cave-dwelling fish have been imprisoned for countless generations. The theory has also a great advantage over the "use and disuse" idea in that it can furnish with a satisfactory reply those critics who attack the latter on the question of the Chinese foot-binding practice.

I put as a last example in support of my theory the phenomenon of the absence of pigment from the egg-shells of those birds which habitually lay their eggs in the dark, while those that lay in more or less exposed places usually produce eggs whose shells harmonise in some measure with their surroundings. Natural Selection is the obvious explanation of the latter; but the theory I have just put forward seems to be not only the most probable, but the only explanation of the former. The pigment, unlike an organ of work, vision, or hearing, can hardly be supposed to dwindle from want of use, nor can its disuse be directly appreciated by, or have any mechanical effect on, the embryo bird. To say that those birds which lay pigmentless shells can consequently make a better yolk and albumen and so produce stronger young which tend to be selected is equally absurd. Therefore the conception of "Natural Retention" retaining those birds having a factor for pigmentless shells and, by crossing, ultimately reducing almost to zero the mode of the race in respect to egg-shell pigment, is the only one possible.

Yours, etc.,
GILBERT S. HARTLEY.

BASFORD, STOKE-ON-TRENT.
December 27, 1922.

CLIMATIC CONDITIONS IN THE ROCKIES OF BRITISH COLUMBIA

OUR reviewer of a recent book on climates in the November issue of DISCOVERY has stimulated a correspondent from the Rockies to describe with enthusiasm his own climate. Mr. John Gregg writes from Hudson's Hope, B.C., where only fifty white people inhabit a circle of five miles radius. The temperature there varies from 89° to −50° F.; in the coldest weather there are no winds, in the hottest no flies. He speaks of grizzly bears, moose, goats and sheep for the hunter's delight; but the enthusiast on grizzly bears may be a little diffident in making the journey thither, for it is 250 miles from a railroad. We are glad to hear that, none the less, DISCOVERY managed to get there!

ACROSS THE SAHARA ON MOTOR-CARS

THE recent successful expedition of the Citroën cars across the Sahara has been an interesting and useful experiment. There were nearly two thousand miles of desert to cross; wells were sixty miles apart, and in the centre of the route taken lay the Tanesruft, two hundred miles in length and possibly as desolate an area as any on earth. The camel has hitherto made desert travel possible, and Captain Haywood, who in 1910 travelled the same route as that taken by the expedition, has written in his book, *Timbuctu and the Great Sahara*, of the risks and trials associated with a caravan expedition on camels. Motor transit in ordinary cars is unsatisfactory on account of the nature of the ground travelled over; the back axles frequently break. The caterpillar tread of the cars used in this expedition appears to have proved efficient in overcoming this difficulty.

The expedition followed, for the first two hundred miles of its way, a dried watercourse known as the Wad Mya. Many a British soldier will remember these romantic channels through the desert, carved and moulded like a cavern in the Arabian Nights, where at long intervals a rushing torrent flows when the rains fall—sometimes only once in seven years. In ancient Egypt there was a myth that those who died during each day collected at nightfall by the gate of Tuat, or the other world, which ran, parallel with Egypt, out in the desert. Throughout its length there ran a river, along which there floated the sun-god and the souls of the righteous to the land of Osiris and the great god Rā. To be sure, we paint our heavens to the pattern of our earth, and doubtless the Nile-born Egyptian could not imagine a riverless eternity. But perhaps his conception was helped by the memory of some such desert torrent as that whose course the twentieth-century Citroën adventurers travelled on their way to desert-encircled Timbuctu.

The expedition left Tugurt, the terminus of the railway south of Biskra, on December 18, and reached Timbuctu on January 7. Despite many difficulties on the way, including a sandstorm and an attack by Arab banditti, M. Haardt (Director of the Citroën Factory) and his followers covered the distance at an average of a hundred miles a day.

RAILWAY ELECTRIFICATION

THE author of the article on this subject appearing in our January issue regrets that he made an error in stating the line voltage of the Brighton Railway. Like all single-phase railways, this voltage is considerably above anything practicable with continuous current. The line is at present worked with a line pressure of 6,700 volts and, when further extensions are taken in hand, it will be raised to 11,000 volts. We would also take the opportunity of saying that the paper on "Electric Railway Contact Systems," referred to at the end of the article, is by Sir Philip Dawson, and contains much interesting information as to the results of working with the single-phase system on that railway.

DISCOVERY

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Binding cases for Vol. III, 1922, are now ready. Price 2*s.* 6*d.* net each; postage, 9*d.*

Editorial Notes

The response to the appeal in our January number for criticisms and suggestions has been most gratifying. A large number of correspondents, from many parts of the English-speaking world, have established our opinion that Discovery fulfils a very definite purpose, and have supplied us with many helpful suggestions. It was not to be anticipated that there should have been complete unanimity of opinion as to the most desirable subjects for treatment in a journal of this nature. It is certain that an individual who could take equal interest in all the articles of any one number of Discovery would be exceptional. But that is a matter for pride rather than regret; our correspondence has shown that one section of our readers finds most acceptable what another finds rather outside his sphere of interest. We aim at putting the individual in the widest possible relationship with the world of to-day and the world of yesterday—and, if possible, with the world of to-morrow. And we believe that the space we allot to the ancient civilisations of Egypt, Greece, and Rome is helpful in directing our attention at times away from this age of great scientific progress, to the days when man was less learned, maybe, and less incessantly busied, but none the less human and often more sublime.

* * * * *

A suggestion which occurred to several of our readers was that more space might be allotted to Astronomy. Arrangements are being made to comply with this request. Again, several correspondents find philosophy a fascinating subject, and would like to solve the problem of personality, of consciousness, and the real existence of things we appreciate by our five senses. One correspondent shyly suggests mathematics as a subject for an article. Of course, mathematics presents a very special problem. It has been said—rather unfairly—that the scientist is the only man who has anything to say to-day, and the only man who does not know how to say it. It is true that the great difficulty in following the lines along which scientific thought of the moment is travelling arises from the fact that scientists have had to evolve a kind of shorthand of their own in order to refer briefly to ideas which among scientists are familiar. The mathematician has carried this process to extremes, and talks a language which is beautifully concise, but hardly lends itself to the literary method. We should be glad, however, to consider an article which would explain the mysteries of mathematics to those of us who never succeeded in travelling beyond quadratic equations.

* * * * *

Many other useful suggestions are being considered, and, if possible, arrangements will be made to provide articles dealing with subjects in Biology, History, and Physics to which readers have referred. We trust that all—including a vivacious but anonymous lady correspondent from Arizona, and a friend who writes, as a working blacksmith, to offer a useful criticism—will continue to advise and criticise us with the kindness they have manifested in the present correspondence.

* * * * *

There are two extreme points of view with regard to the relationship between science and industry. The first was that of the successful steel magnate, who brought his son to a university with directions that he should be taught steel, and steel only. The second inspired an enthusiastic mathematician, at the close of a dinner held by a learned society, to call for the toast "Here's to pure mathematics—may it never be any use to anybody." It is, in fact, impossible to divorce the search for scientific truth from the tireless

effort to exploit the world's resources, and link together the four corners of the world in the great web of modern industry. There is no fact, however insignificant it appears, which may not come to have a bearing on the daily life of mankind. In a sense, the doctor, the scientist, the lawyer, the politician, and the journalist all work for one object—the safety and development of industry. The naturalist who, with butterfly net and specimen box, has often been pointed at with derision as a type of the futility of purely scientific energy, has been the means of making possible the cutting of the Panama Canal by destroying the insect pests that spread disease and death. We would even venture to say that, if great discoveries are to be made, they must come from the investigation of seemingly "useless" phenomena. When the value of a scientific discovery is established for industrial purposes, it may be developed to a very high degree of efficiency, but its limitations can be imagined from the beginning. It is of the essence of the completely new discovery that it was inconceivable before discovery, and how can such knowledge come save by constant disinterested efforts along ways never ventured on before? How many invaluable marvels, from the X-ray to Radium, have come to light as accidents of the laboratory?

* * * * *

The words of Sir Alfred Yarrow, in making his recent gift of £100,000 for the furtherance of scientific research, deserve to be quoted in full: "I should like to record my firm conviction that a patriotic citizen cannot give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends." It is a matter for special satisfaction that this splendid gift has been earmarked rather for the support of scientific investigators than for building homes of research. In spite of the work of the Medical Research Council, and the grants by the Royal Society towards research in general, this country remains a long way behind America, and even Germany, in its provision for scientific workers. There are, fortunately, if not enough, at any rate a satisfactory number of institutions for scientific study. But the scientist is more important than his house; a scientist could, conceivably, work in the open, whereas even the largest laboratory is comparatively valueless without an inhabitant. And undoubtedly many of those best fitted for the task of new discovery cannot undertake it from financial reasons, while those who do must spend a large proportion of their time, not in original work, but in the exposition of the elements of their lore to students. We hope that these and many other problems at present confronting scientists and their work will be satisfactorily resolved during this decade.

Plants as Travellers

By A. C. Seward, Sc.D., F.R.S.

Master of Downing College and Professor of Botany in the University of Cambridge

The publication of a paper by a Dutch botanist, Dr. Leeuwen, in the last number of the Annals of the famous botanical garden of Buitenzorg, in Java, enables naturalists to follow to a further stage the results of one of the most remarkable experiments made by Nature of which we have any record. Dr. Leeuwen's contribution is the most recent addition to a collection of facts, accumulated at intervals during the last thirty-six years, illustrating the capabilities of plants as travellers and as colonisers of bare ground. The author describes the vegetation of the small islands of Krakatau and Sebesi in the Sunda Strait between Java and Sumatra as he saw it in 1919 and 1921. A brief statement will suffice to show that the vegetation of these Malayan islands is, from a certain point of view, more interesting than that of any other region in the world. Lying about midway between Java and Sumatra is a group of islands including Krakatau, Verlaten, and Lang Island; between Verlaten Island and Sumatra is another island, Sebesi.

The Eruption of Krakatau

It is with Krakatau that we are primarily concerned. In the early part of 1883 Krakatau was five and a half miles long and three and a half miles broad; on the south side the peak Rakata rose to a height of nearly 3,000 ft. The whole of the island, from sea-level to the summit of the mountain, was covered with an impenetrable tropical forest. Krakatau was known to be volcanic, but it was believed to be extinct. In the course of the summer of 1883 the long-dormant volcanic forces awoke, and there were repeated explosions and showers of ash and pumice. Towards the end of August the climax was reached: at places in Java, 100 miles away, the noise of the explosions resembled artillery-fire at close range, and it is stated that sounds were heard on the island of Rodriguez 3,000 miles from Krakatau. Villages on the island of Sebesi, twelve miles distant, suffered the fate of Pompeii. Volcanic dust fell in enormous masses over a wide area, and some of the finer particles floated in the higher regions of the atmosphere round the world, causing, as I well remember, brilliant twilight effects in England in December 1883. When all was over it was found that two-thirds of Krakatau had been blown into space: the peak Rakata had been split from base to summit; a vertical precipice replaced its forest-covered slopes. The green island teeming with life had been converted into a lifeless desert covered

with volcanic ashes to a depth of from 90 to nearly 200 ft. We are assured by scientific men who visited the remnant of the island in 1883 that no living thing could possibly have survived. Thus ended a tragedy in which the actors were the volcanic forces hidden below a mountain clothed with a tropical jungle.

A "Miracle of Earth Re-clad"

From this stage onwards we are able, partially at least, to follow the steps of botanical reconstruction, to follow Nature as she "strewed flowers upon the barren way" and worked the "miracle of earth re-clad." In 1886, three years after the catastrophe, a Dutch botanist, the late Professor Treub, visited the island: he found a few pioneers already established on the beach and others in the interior of the island, both ferns and flowering plants. The plants near the sea had germinated from seeds washed up on the beach and carried from neighbouring islands by currents, while those farther inland possessed fruits or seeds adapted to dispersal by wind. Dr. Treub made the interesting discovery that the inhospitable surface of the volcanic dust and pumice had first been occupied by members of the Blue-green Algæ, small, lowly organised plants able to live under conditions which are impossible for the higher forms of life, and readily carried through the air in the form of minute, dust-like spores. These simple organisms covered the surface of the ground near the shore and in the ravines on the mountain slopes with a slimy film which enabled the spores and seeds of the higher plants to obtain a hold on life. It was afterwards found that bacteria and moulds were introduced at an early stage and played their part as an advance-guard for the army of more highly organised members of the plant kingdom.

In 1897, fourteen years after the sterilisation of the island, another visit was paid to Krakatau: sixty-two species of vascular plants were collected, that is, plants higher in the scale than mosses; since 1886 there had been many new arrivals and in places the ground was covered with vegetation. Nine years later, in 1906, a party of botanists spent some hours on the island, and a full account of their work was subsequently published by Professor Ernst, of Zürich, and translated into English. Professor Ernst wrote: "As we approached the east coast of Krakatau we noticed with growing amazement the remarkable progress made by the vegetation. Almost the whole south side, from the beach to the summit and to the edge of the steep promontory, is covered with green. On the south-east coast, where we first thought of landing, a belt of forest runs parallel to the shore, in which we could recognise from a distance numerous grey-green Casuarina[1] trees. Farther to the south rose the dark green

FIG. 1.—A COCONUT PALM ON THE BEACH OF KRAKATAU, PHOTOGRAPHED BY PROFESSOR ERNST NINETEEN YEARS AFTER THE ERUPTION.
By kind permission of the Cambridge University Press.

[1] Casuarina is a genus of trees represented by several species in Australia, Polynesia, and other regions in the Southern Hemisphere; it is characterised by green, pendulous, whip-like branches, and in some places is known as the She-Oak.

leaves of coconut palms in association with slender, broad-leaved trees bearing whorls of branches. Isolated trees and shrubs were seen on the low-lying ground which rises gradually to the base of the conical mountain ; in some of the ravines half-way up the hill they form patches of forest, reappearing as scattered plants on the higher ridges and on the peak."

Some of the trees had already reached a height of 49 ft. The beach was littered with the flotsam of the waves—fruits, seeds, and branches of common Malayan plants carried from Java, Sumatra, or other islands ; within this drift-zone the ground was festooned with

FIG. 2.—THE TALLEST TREE AND SOME DENSE VEGETATION ON KRAKATAU, ALSO PHOTOGRAPHED BY PROFESSOR ERNST. *By kind permission of the Cambridge University Press.*

the trailing stems of a blue-flowered tropical Convolvulus and the runners of the grass Spinifex. Above the network of creeping stems rose shrubs of Hibiscus and many other plants, some of them covered with the thread-like stems of a parasitic Dodder. Ants, gnats, and wasps were unpleasantly abundant. One of Professor Ernst's photographs, reproduced in Fig. 1, shows a young coconut palm at the upper edge of the tide-level and, to the right, a shrub festooned with the stems of a Dodder (*Cassytha filiformis*). Fig. 2 affords an impressive illustration of the progress made by the vegetation : Professor Ernst's photograph shows the tallest tree, nearly 50 ft. high, supporting the climbing stems of a vine, and a belt of younger trees in the foreground.

The Return of Dense Vegetation and Animal Life

Dr. Leeuwen's visit to Krakatau in 1919, and in 1921 to the neighbouring island of Sebesi, which was almost completely devastated in 1883, furnished material of considerable interest. He writes of Krakatau : " The visitor who is not a naturalist, deceived by the dense vegetation now clothing the island, will fail to imagine and realise how at one time everything was destroyed and all plants and animals on the island were annihilated." A snake 18 ft. long was found, sixteen different kinds of birds, two reptiles, thirty-two kinds of spider, nearly two hundred species of insects, and other animals including some land-snails. The occurrence of land-snails is noteworthy as it has generally been supposed that they are restricted to migration-routes on land : they are apparently capable of taking a sea-voyage. Their presence on an island does not therefore necessarily mean either introduction by man or a former connection between the island and a neighbouring continent. Since 1906 the number of forest trees had considerably increased ; there were many more epiphytes, that is, plants which obtain a place in the sun by living on the stems of trees and have no direct contact with the ground ; also several additional Vascular Cryptogams—plants belonging to the group which includes the ferns, club-mosses, etc. The total number of vascular plants so far determined from Krakatau is 259, in addition to numerous lower forms of plant life.

" The key of the past, as of the future, is to be sought in the present " : by these words Huxley wished to emphasise the importance of exhausting all known explanations of phenomena before calling to our aid causes which are unfamiliar. The history of the botanical colonisation of Krakatau gives us the means of picturing similar processes at different stages of the world's history. The view adopted by Darwin in the *Origin of Species*, and now generally accepted, is that each kind of plant was first produced at one place ; it had a " single centre of creation." Leaving out of account the large part played by man in distributing plants, we must assume that the occurrence of the same species in widely separated regions means that it has travelled far from its original home. Darwin and other naturalists have contributed many facts based on observation and experiment which throw light on the ability of plants to be spread by natural agencies—by water, wind, and animals. The re-clothing of Krakatau with tropical vegetation from sources separated from it by several miles of sea is the most striking and illuminating example of the efficiency of plants as travellers and

as colonisers of bare ground which has ever been recorded.

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Is Tutankhamon Buried in the Newly Discovered Tomb?

By T. E. Peet, M.A.

Professor of Egyptology in the University of Liverpool

THE closing down of Tutankhamon's tomb for the summer postpones for the time being the solution of the question whether this king himself is actually buried within the nest of shrines. In the meantime a French scholar has made the disturbing suggestion that this is not the tomb of Tutankhamon at all, that having already been found elsewhere in the great valley. It may not be without interest to readers of DISCOVERY to be made acquainted with the facts on which this last statement is based.

In the winter of 1906 an American millionaire, Mr. Theodore Davies, who, with the late Mr. Edward Ayrton as his archæological expert, was searching for tombs in the Valley of the Kings, was attracted by a large rock tilted to one side, and on turning over the stones beneath and around it, found a small but beautiful cup of blue fayence bearing the name of Tutankhamon. This suggested that the king's tomb might be somewhere in the vicinity. It was not, however, until the following season that a tomb was found, a short distance to the north of that of Horemheb, which appeared to be that sought for. At a depth of 25 ft. below the surface a chamber appeared in the rock face, almost completely filled with dried mud deposited by the flood-water of centuries. In this were a magnificent statuette, perhaps a *ushabti*, of alabaster, and the remains of a wooden box containing several pieces of gold foil bearing in relief scenes of peace and of war, with the cartouches of Tutankhamon and his wife Ankhesenamon, and the names of the priest Ay and his wife Ty, these last without any royal titles. Ay was Tutankhamon's successor on the throne, only to be supplanted after a short reign by Horemheb, the founder of the XIXth Dynasty. At a short distance from this tomb a pit was found filled with large pottery jars which appeared to contain the debris from a tomb, and in particular the remains of funerary wreaths and garlands. The cover of one of these jars was broken and had been replaced by a wrapping of cloth bearing the name of Tutankhamon.

Such are the facts about the supposed tomb of Tutankhamon. They lend themselves to more than one conjecture. Mr. Davies believed that the tomb was that in which Tutankhamon was originally buried, that it had been plundered, and that when this was discovered the body and furniture were removed elsewhere for safety, such remains as were not considered worth moving to the new tomb being buried in a pit hard by. In view, however, of what may be discovered next winter, it would be foolish to indulge in further speculations now. The funerary furniture found by Lord Carnarvon appears to be that of Tutankhamon. The great wooden shrine is marked with his name, but we have as yet no information with regard to the inner shrines and the coffin which they may be reasonably supposed to conceal. We cannot be certain that the tomb was originally intended for him until we are assured that the inscriptions on its walls are in his name, and that the cartouches contain no alterations. This is not scepticism, but merely reasonable caution. Tyi's tomb contained not Tyi but Akhenaten, and that of Amenhotep II contained eight other royal mummies in addition to that of the true owner. Who can tell what incongruous changes may have been made by priests anxious to preserve royal bodies from plundering and desecration, or by religious enthusiasts eager to purge the country of the taint of heresy brought upon it by Akhenaten and his immediate successors?

If, then, the Carnarvon tomb is truly that of Tutankhamon, to whom are we to attribute that found by Mr. Davies? Certainly not to the priest Ay, for his tomb has been found elsewhere, in the Western Valley as it is called. There his great sarcophagus is still to be seen, and near it on the walls the portraits of the king himself and his wife, whose names have been carefully erased wherever they occur. Were they, then, followers of Akhenaten's heresy, or was it merely as usurpers that they earned the obloquy and persecution of later days? Probably the latter. It is clear, from the great stela which Tutankhamon set up at Karnak after his return from Tell el-Amarna to Thebes, that his reversion to Amon worship was complete and genuine. After a reign of probably little more than

six years [1] he was succeeded by Ay, the monuments of whose short reign (minimum four years) show every sign of rigorous orthodoxy.

The Davies tomb thus remains a mystery, and will continue to remain so should the new tomb, as seems probable, prove to be really that originally intended for and actually used by Tutankhamon.

Geological Results of the "Quest" Expedition

G. Vibert Douglas, M.C., M.Sc.

Geologist on the "Quest" Expedition

It was the original intention of Shackleton to explore those portions of the coast of Antarctica which lie south of the Atlantic and Pacific Oceans. To be precise, his first objective lay between Enderby Land and Coats' Land, his second objective between Charcot Land and King Edward VII Land. These two portions of coast have never been seen by man. On the routes to and from these objectives he intended to call at those seldom-visited islands in the Atlantic, Southern, Indian, and Pacific Oceans. This programme, while not of the spectacular nature of a dash to the interior of the continent, was one calculated to add considerably to our knowledge of the globe. Owing to the death of our leader, the unsuitability of the ship for ice navigation, and the conditions of the ice, only a portion of the last-named objective was attained.

The islands of Madeira, St. Vincent C.V., and St. Paul Rocks were visited on the way out, but space will not admit of their being mentioned here.

South Georgia

The island of South Georgia, which is 116 miles long by 20 miles wide, lies in lat. 54° S. 900 miles east of Cape Horn.

It was first sighted by Amerigo Vespucci in 1501, again by Antony La Roche in 1675, but was claimed for Britain by Captain Cook in 1775. After sailing around the island he recorded in his diary that it was unfit for human habitation, and he decided to call it the Isle of Georgia in honour of His Majesty George III. Little did he think that 140 years later it would give occupation to a thousand men and support so important an industry as the Southern whaling is to-day.

The physical features are those of an upland deeply eroded by glacial action. The highest peak, Mount Paget, is about 8,000 ft., but the average monument is only 2,000 ft., above sea level. The average valley elevation would probably be about 600 ft.

The glacial valleys run in general across the longer axis of the island, so that one sees valley after valley separated by comb ridges.

In the classification of Hobbs it is a fretted upland with the development through glacial action of monuments and comb ridges. There is some evidence of a general uplift, but in the opinion of the writer most of the low ground 50 to 70 ft. above sea level is the result of cosmic action rather than that of the sea.

In general it may be said that the glaciers show signs of withdrawal. One particular investigation was carried out at Royal Bay, where the Ross Glacier comes down to the sea. It was measured by the Gauss Expedition of 1882, again by Duse of the Nordenskjold Expedition of 1902, and by us in 1922—intervals of twenty years. These measurements show the fact that there was an advance of the foot of over 4,000 ft. during the period 1882 to 1902, and that now it is back in the position of 1882. It is suggested that this does not indicate any general advance or withdrawal, but rather that the glacier, to use an hydraulic term, is operating under a high head and is being forced out to sea, where the foot is afloat. It will continue to advance until the effect of the rollers on the floating mass of ice overcomes the tensile strength of the ice and it breaks away. If we assume that twenty years represent this period (it may be a multiple of a smaller period), then this gives an advance per year of about 220 ft.

Vegetation is limited to the lower slopes facing the sea, where there is plenty of tussock grass, which is capable of supporting, and does support, imported reindeer. There are ferns and lichens growing in the crannies of the rocks. Lettuces, radishes, and carrots are grown under glass at Husvik.

The greater part of South Georgia is composed of sedimentary rocks, but running inland from Cooper Bay there is an igneous contact. To the east of this contact an igneous complex exists.

The sediments,[2] which are of the nature of mudstones, shale, slate, phyllite, quartzite, greywacke,[3] marble, and tuff, most probably represent one great series of deposition. Owing to a complicated series of folds, faults, and sheared zones in many places, one would think that an unconformity existed and, until there has been more detailed work done on the island, it will not be possible to say definitely whether there are two main series or only one.

The sediments have been so contorted that most of

[1] The statement in my article in Discovery, No. 38, p. 32, that we have no year dates of Tutankhamon needs correction. In the tomb of Tyi was found a vase containing a piece of linen on the edge of which was written in ink "Year 6 of Tutankhamon."

[2] Mr. G. W. Tyrrell, A.R.C.S., F.G.S., Glasgow University.

[3] Dr. W. T. Gordon, D.Sc., King's College, London.

the fossil evidence has been destroyed. A petrified stem of an Araucaria was found on an island in the Bay of Isles and would point to an age not later than Lower Carboniferous.[1] An examination of some of the slates has been carried out, but yielded no evidence of great importance.[2]

With regard to the igneous geology of the island,[3] two areas were studied. North of Drygalski Fjord, there is an interesting complex consisting of:

Quartz diorite plug Two ages of gabbro	Complex system of dykes (peridotite, vogesite, dolerite).

A little to the south-east, but forming part of the same area, there are twelve parallel dykes. The lower one of these was reached and proved to be differentiated, gradually grading from wall rock, which was a gabbro, to a quartz diorite, a biotite granite, and finally alaskite. At Larsen Harbour, which is on the south side of Drygalski Fjord, the rocks were more basic.

Epidosite (on top) Spilitic lava Gabbro	Two systems of doleritic dykes.

It is believed by the writer that the lavas were poured over gabbro, or, in other words, the gabbro is not intrusive into the lavas.

The general strike of the rocks is parallel to the longer axis of the island, and the dips are mainly toward the south-south-west. The folding and faulting on the north-east coast are thought to be the result of pressure either from the south-south-west or north-north-east.

Zavodovski, South Sandwich Group

This island was not landed on, but the following observations were made from the ship.

The island appeared to be a volcanic cone rising to about 1,200 ft. At the base there was a compact columnar basalt.[4] Above this, a line of red cinder, and above this, rough pahoehoe lava forming the surface. Sulphurous fumes were issuing from cracks in the cliffs at one or two points. The rock fragments brought up by the Kelvin sounding machine confirm the basaltic nature of the rock.

Elephant Island, South Shetland Group

The topographical features of this island are those of a dome-shaped plateau, 300 ft. at the rim and rising gradually to 1,200 ft. in the interior. It is covered in an ice sheet. The glaciers appear to be more of the hanging type than of the valley type.

The observations of J. M. Wordie[5] on the north coast, and our observations at Minstrel Bay on the west coast, would indicate that the northern part of the island is composed of contorted siliceous phyllites.[6] The strike of the rock strata is about N. 95° E. with vertical dips. No faulting was observed, but horizontal jointing was commonly met with.

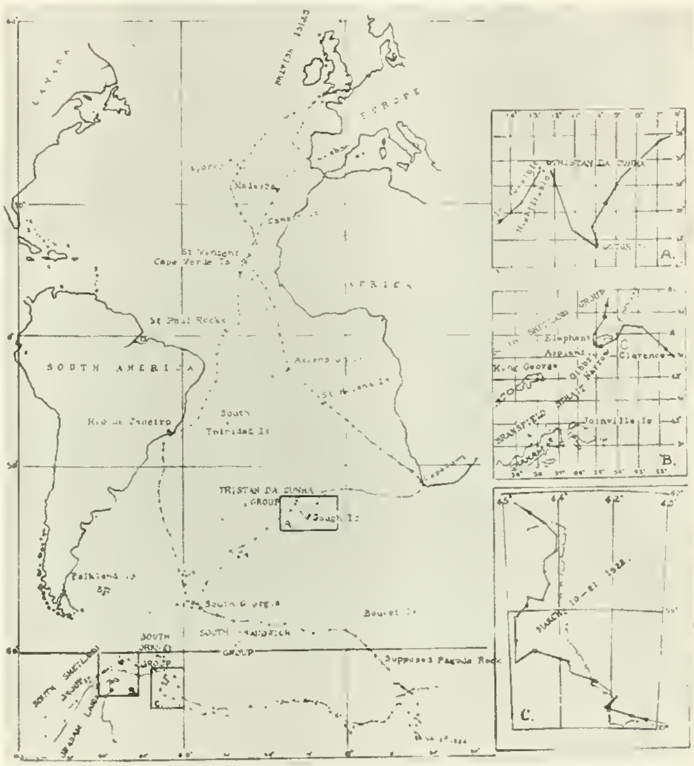

FIG. 1.—MAP OF THE *QUEST'S* TRACK.

At Cape Lookout, however, an entirely different set of conditions was seen. There is here a metamorphic series, which consists of the following in order from the sea towards the north[7]:

Quartz hornblende epidote schist.

[1] The Carboniferous period is one of the subdivisions of the Palæozoic period, which yields the remains of the earliest living things.

[2] Dr. G. L. Elles, D.Sc., Newnham College, Cambridge.

[3] Igneous rocks are those which have been erupted from below the earth's crust—an example is granite. They are classified according to the amount of silica which they contain. Thus gabbro contains about 50 per cent.; quartz diorite, 65 per cent. "Basic rocks" are those which, like gabbro, contain the least silica.

[4] Basalt is an igneous rock. The isle of Staffa is mainly composed of it; the tall black columns are typical of this rock.

*

[5] James M. Wordie, M.A., "S.y. *Endurance.*"

[6] Phyllite is one of the metamorphic rocks. These are rocks which were either originally igneous or deposited by sedimentation from water, but have been modified by heat or crushing, and differ widely from their original forms. Quartz, hornblende, albite, etc., are various forms of the element silicon—familiar to us in the form of flint—in conjunction with soda, aluminium, iron, etc.

[7] Dr. C. E. Tilley, Ph.D., Cambridge.

Garnet albite schist.

Garnet albite schist with mica and hornblende banded with a sandy limestone.

Tristan da Cunha Group

This group, consisting of the five islands, Tristan, Nightingale, Middle, Stoltenhoff, and Inaccessible, lie in lat. 37° S., long. 12° W., which is about 1,500 miles west of Cape Town.

It was discovered by Tristan da Cunha about 1508, but only became inhabited about the beginning of the nineteenth century when Napoleon went to St. Helena.

The island of Tristan is a volcanic cone rising to 6,400 ft. In shape it is an octagon about eight miles across. The first 2,000 ft. are very steep, but after this the slope is 17° or less.

At 3,200 ft. the slopes become deeply indented with drainage ravines. These continue for about 500 ft., when the slopes become very rugged with minor rocky knobs. This rough surface continues up to 5,700 ft., where the final cinder cone begins. The old crater at 6,300 ft. now forms a snow-water lake. The vegetation line is about 3,800 ft. above sea level.

The mountain is built of successive flows of lava mainly basaltic in character. Many vapour vents occur, and the rock varies from compact to very vesicular in texture. The lowest lava forms a lava plain at the north side of the island, and this plain has a number of small cones which represent the second and last stage of vulcanism. These observations were made on the line of section from the Peak to Herald Point and westwards to just beyond the Hardy Rocks. That a more complex state exists in the neighbourhood of Swain Bay is evidenced by the specimens given by the islanders to the writer. These might almost be said to be plutonic, but it is thought [1] that they are of the nature of bombs.

To the west and about twenty-two miles from Tristan there are the four islands mentioned above.

Nightingale, the southernmost of the four, is rectangular in shape, and in size one mile by three-quarters. High cliffs bound the south, east, and west sides. The northern slopes descend gradually to the sea, where they terminate in cliffs about 50 ft. high. The highest point is on the east of the island and is about 1,000 ft. above sea level. It is connected by a low-featured col to the high land on the south-west. To the west, that is towards the interior of the island, there is a depressed area which has now a small pond in it. It is probable that this was once the crater from which the lavas issued. They are mainly composed of trachyte—a volcanic rock which is common in Scotland.

FIG. 2.—TYPICAL SEDIMENTARY ROCK SCENERY, PRINCE OLAV HARBOUR, SOUTH GEORGIA.

Middle Island lies less than half a mile to the north of Nightingale. It is about a quarter of a mile square and rises to a height of about 200 ft. It is flat-topped with minor depressions.

There have been questions asked as to the origin of Middle Island, and to the writer, who had this in mind

[1] W. Campbell Smith, M.C., M.A., Brit. Mus. (Nat. Hist.). Plutonic rocks are those which have been thrust through overlying rocks from below in a liquid condition. Bombs have been cast forth as round masses from volcanoes.

when visiting the island, the following were the reasons for its existence. The flows of light-coloured lava from Nightingale probably extended at one time about a mile farther to the north than the present northern shore of Nightingale. This is evidenced by the trachytic agglomerate and trachyte seen on Middle Island. Following this there was an effusion of a hard compact lava from a neck which exists on the latter island. The border of the neck is marked by a breccia. The dykes emanating from this lava are not seen on Nightingale, but some of the rocks which infest the channel between the islands are probably their eroded remains. The action of the sea on the mass of altered trachyte between Middle and Nightingale has in the course of time cut a channel through.

Stoltenhoff Island

It is not possible to land on this island as it rises sheer from the sea to about 200 ft. It is flat-topped and in area about 500 yds. by 150 yds. The rock of which it is composed appears to be of a trachytic nature and may be the northern limit of the flows from Nightingale which have already been mentioned; it may, however, be a centre of activity such as is described as existing on Middle Island.

Inaccessible Island

Eleven miles to the north-north-west of Stoltenhoff is this island, which is the most northerly one of the group. It is pear-shaped in appearance, being about three miles by two and a half miles.

In its general features it is a basin—a great caldera the south-eastern side of which has been blown out. A cone rises to about 1,500 ft. towards the north-east of the depressed central area. The interior is broken country clothed in verdure, and on account of the high rim, which affords protection from the winds, would be suitable for human habitation. A stream winds through the interior, finally falling in a beautiful cascade, to the beach at the north-east shore, where a landing is easily made if the wind be not from the north.

The central cone is a mass of light frothy lava, and the section from here to the sea near the waterfall shows that there have been successive flows of basalt and trachyte. The high cliffs to the west of the landing are cut by a series of parallel dykes which are an imposing feature.

FIG. 3.—LOOKOUT HARBOUR, ELEPHANT ISLAND.

Gough Island

Gough Island lies roughly 280 miles south of the Tristan da Cunha group. It is eight miles long by three miles wide, and forms a monoclinal block with dip slopes to the west and escarpments to the east. The highest point on the long ridge which runs down the longer axis of the island is about 2,915 ft. above sea-level. The west side of the ridge goes down in a long slope to the cliffs bordering the sea.

The escarpments on the east side are cut by three or four glens; the largest one, about half-way down the coast, gives access to the interior. The most striking feature looking up the glen is the great stock of an acid intrusive rock which rises to 2,270 ft. It can best be described in the words of Scott:

> "Shooting abruptly from the dell
> Its thunder splinter'd pinnacle."

Thick mosses and bracken grow in the glens and two types of tree were found. In the smaller glen, to the south of the main one, there is a species of Sophora,[1]

[1] G. H. Wilkins, M.C., F.R.G.S., Naturalist.

which is the farthest point south at which this tree has ever been reported. The other and more hardy tree is a type of Phylica.

The island is the result of a series of fissure flows of a basaltic and trachytic nature. These flows have been intruded by the stock just mentioned above, and many fissures were opened by it; these have subsequently been filled by dykes. The rock forming these dykes is very hard, with the result that they are now a very prominent feature and stand up in some cases about 50 ft. above the surrounding country, due to differential weathering.

It is probable that the east coast represents a fault plane, but as the erosion has been great, direct evidence is wanting. Apart from this fault, no folding nor faulting was observed.

The expedition then proceeded to Cape Town, where it received orders to return home.

Looking back over the many miles traversed, where mighty forces are working unseen by human eye, memory discloses numberless open doors inviting the adventurous spirit to enter, and it is with sincere regret that we had to pass them by, being well aware that Nature has laid bare the story of her history to the careful investigator, but from the casual observer she withholds her deeper secrets.

Some Types of English Place-names

By Allen Mawer, M.A.

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PLACE-NAMES denoting human habitations, as distinct from those which are applied to natural features, may roughly be divided into two main types. There are those which are descriptive of the site of the place itself and those which primarily take their name from their founder, owner, or tenant, even though the suffix may be more or less vaguely descriptive.

The latter are as a rule a good deal more interesting than the former, for the personal name is seldom more than a name to us. It is only very rarely that we can with any measure of certainty identify the person with any well-known historical character. There are few cases like *Bamburgh*, which we know to have been called after *Baebba*, the queen of Aethelfrith of Bernicia, or *Portsmouth*, which, if the legend be true, preserves the name of *Port*, one of the leaders of the Saxon invasion of Hampshire.

Place-names Based on River-names

Of the former type the earliest are undoubtedly those which are based on river-names. In grants of land in Saxon times we find, again and again, that the land was given, not as it would now be, at such and such a place, but by such and such a river—Stour, Avon, or whatever it may be. This practice has left a deep impression on our place-names. Sometimes, as in *Watchet*, *Frome*, and *Darenth*, the river-name has in course of time come to be tied down to one place on its banks. More common, at least in certain parts of the country, is the practice of applying the river-name to a whole series of settlements on its banks, and then distinguishing them from one another in later times by prefixing or suffixing some second element. Hence we get such series as *North Cray, Foots Cray, St. Paul's Cray, St. Mary's Cray* in Kent, the Wiltshire *Winterbournes*, the Gloucestershire *Colns*, the Devonshire *Clysts*. Dorsetshire is the great home of names of this type; in the North of England they are notably absent, but in Essex we have perhaps the most curious example of this method of naming settlements on a river. The names *Ingatestone, Ingrave, Frierning, Margaretting, Mountnessing* in their common element, namely *ing*, reveal all that remains of an old river-name which lies behind the present-day *Wid*.

Most common of all, however, are those cases in which some *ton* or *worth* or *wick*, or whatever else it may be, has taken its distinctive name from the river on which it stands—*Cirencester* from the *Churn*, *Frampton* from the *Frome*, *Davenport* from the *Dane*. Names of this type are of more recent origin than those just discussed, as is happily illustrated in *Bledington* in Gloucestershire, on the *Bladen* (now called the *Coln*). In the earliest reference to it it is called *Bi Bladene*. Very curious are some of the transformations which some of the river-names have undergone, obscuring the whole history of the names involved. An early river-name *Alum* in Somersetshire gave rise to an *Alhampton* and that in its turn has given rise to a river *Alham*. Who would suspect that *Dewlish* in Dorset takes its name from the original form of the name of the river on which it stands, now called the *Devil's Brook*, or that the same river-name has given rise to the *Devil's Water* in Northumberland and forms the first element in the name of *Dilston* on its banks? The old river-name *Gifle* (pronounced *Yivle*) is found in *Ilchester* (earlier *Givelceaster*), *Yeovil* and *Yeovilton*. These all stand on a river now called *Yeo* rather than *Yeovil*, as it ought to be called. Some ingenious person could not apparently be content with a town called *Yeovil* without making it into the *vill* on the *Yeo*. The same river-name lies behind *Northill, Southill*, and *Yielden* in Bedfordshire.

Side by side with such names as these we have others which attempt to show the precise position of places in relation to a river or rivers. The *Mittons, Muttons,* and *Mytons* are all on the *mythes* (a derivative of *mouth*) between the meeting of two streams. *Twining* in Gloucestershire means "Between two streams," and so did *Twyneham,* the present-day Christchurch. The North Country *twistles* are all at the *twisel* or fork of two streams, while *Beckermet, Beekermonds, Eamont,* and *Emmott* are all at the "meet" or "moot" of two becks or rivers (Anglo-Saxon *ea*).

Names Compounded with "At"

One curious trick of Old English place-nomenclature, going back to very early times, was the method of speaking of a place, not as "X" but as "At X." In large numbers of charters the regular formula is that the grant is made at the place "which the rustics call 'At X.'" One shrewdly suspects that this was by then nothing but a legal formula and that it was the lawyers rather than the rustics who thus called it. The old custom has, however, left its very definite mark in place-names. Dr. Bradley long since pointed out that the many English river *Rees* or *Reas* went back to Middle English *at ther ee* (= at the river), becoming by misdivision *at the ree.* *Thurleigh* in Bedfordshire, pronounced *Thurly* with the stress on the last syllable, is a yet more curious instance. Its early forms are variously *Leye, Therlye,* and *Relye.* All can be explained from an early *at there leye* (= at the meadow), alternatively misdivided to *at the relye, at therlye,* or, with no preposition or article, simply *Leye.* The importance of these misdivisions in giving rise to fresh place-name forms is neatly shown in a Buckinghamshire charter which mentions *Yttingaford,* the scene of the peace between Alfred and Guthrum, and a road called the *Theodweg* (i.e. the national road). Mr. Gurney of Egginton has identified these as *Tiddingford* Hill, where the *t* of *at* has got tacked on to the front of the name and *The Ede Way,* where the initial *th* has with equal ingenuity been chopped off.

Descriptive Place-names

Another very common type of place-name is that whereby the position of a group of settlements is defined in relation to some common centre or in relation to one another. These *Nortons, Suttons, Eastons* or *Astons,* and *Westons* call for little comment as a rule, though when one or other of the group has dropped out it is often difficult to tell now just why the place is so called. It is noteworthy, however, that the essential vagueness and ambiguity of such names led to curious intensive forms. Side by side with *Westons* and *Astons* we have the comparatives *Westerton* and *Asterton,* and even the superlative *Westmeston.* There are three *Middletons* in Ilderton in Northumberland, and one is commonly distinguished in early times as *Midlest* or *Midelmast Middleton.*

It is clear that our forefathers were a good deal more sensitive than is the average man of to-day to differences of slope and outline. They applied the term *cliff* to many a slope which to our eyes is but a gentle rise (e.g. *Egglescliffe,* co. Durham), and it did not require any very steep gradient for them to call places *Hanging Houghton* or *Hanging Grimston,* or to call a wood a *Hanger,* the source not only of a good many names in *-hanger,* but also of the many *Hunger Hills* scattered up and down England, and probably also of the *Hungry* in *Hungry Bentley* and *Hungry Studley,* now *Studley Royal.* The Anglo-Saxon *hoh* meant originally "a steep overhanging cliff" (allied to the word *hang* itself) and is still found in this sense in the North Country *heugh,* but it is curious to find it, in the form *-hoe* or *-hoo,* applied also to the low spurs of land jutting out into the flats of Bedfordshire and Northamptonshire. This sensitiveness to slight changes of shape has made it at times very difficult, as in the case of the very common suffix *hale,* to determine the precise sense in which certain terms were used. Dr. G. B. Grundy in his work on Saxon Charters has shown how much may be done in this matter by tracing out the bounds of an estate as given in a charter on the actual ground itself

Form and Colour in Place-names

Questions of outline are clearly the cause of many hill-names. *Brokenborough* is fairly common as a hill-name, so is *Holborough* (*hol* = hollow). Less obvious are *Clannaborough* (= cloven hill) and *Sadberge, Sedbergh, Sedborough,* and *Sedbury,* all of which denote a *seat*-shaped hill. The suffix in all these cases is originally *beorg,* "barrow, hill" rather than *burh.* *Hambledon, Homildon, Humbleton* and the like are fairly common as hill-names in England. They are all *hamble*-hills in which the first element goes back to an Anglo-Saxon *hamel,* "mutilated," and they refer to various types of outline, one of the commonest being the rounded or "dodded" hill. *Cronkley* in Northumberland and *Crunkley* in the North Riding both go back to an early *crumbeclif* descriptive of a hill of *crum* or "crooked" outline.

There has been much discussion as to how far we are justified in carrying this idea of the use of descriptive place-names by our forefathers. In reaction against an earlier unscientific school of place-name interpretation which hunted for the picturesque, quite regardless of scientific truth, there has been an inclination on the part of some scholars to deny it almost entirely, and to try to get round the difficulty of interpretation with the aid of personal names, real or imaginary. Others would confine this type within the narrowest limits, and in

any case deny the possibility of there being any question of æsthetic considerations, even in the broadest sense, in the giving of names to places.

There is little doubt among scholars at the present time, however, that descriptive names did prevail to a much larger extent than has been generally allowed. There may have been personal names *White, Black,* and *Brown* in Saxon times, but the mass of evidence goes to show that proportionately they were nothing like so common as those elements are in place-names, and we may therefore assume that in place-names they are very often of purely descriptive force. *Green* and *Red* and *Grey*, the first two of which often appear in place-names as *Grin-* and *Rad-*, are quite unambiguous in early times, for they are not used as personal names in Old English, though *Red* in the form *Routh* is fairly common as a Scandinavian personal name and nickname. We have a good many place-names which are due to the attempt to record the existence of red cliffs, usually of sandstone. *Radcliffe, Ratcliffe, Redcliffe* are of English origin, while *Roecliffe, Rawcliffe,* and *Rockliffe* are similar names in Scandinavian districts. The adjective *har*, "hoar," "grey," is curiously common in place-names. It may in some cases be doubtful whether we have this adjective or the animal-name *hara*, "hare," but there are far too many cases of this element *Har-*, quite apart from those cases where it is a later development of Anglo-Saxon *here*, "army," to allow of its being commonly taken as the animal-name. Specially common are *Harstons* and *Hoarstones*, *Hoarwood* and *Harwood*, *Harwell* and *Hartrow*, in none of which is the animal-name very likely. The adjective *har* was primarily applied to anything that was "grey" or "covered with lichen," and then, at least in the case of *har-stan*, developed the secondary sense of "boundary" (stone). Judging by the large number of *Harwoods* and other places in *Har-* which now lie on the boundary of two parishes, there is some reason to think that this secondary sense may have been extended to other compounds. Lastly, among adjectives of colour we may mention the use of Anglo-Saxon *fah*, "stained," "variegated." This is fairly common in place-names, and does seem to show an appreciation for the finer niceties of colouring in the landscape. We get it in numerous *Fawleys* and *Fawdons* and in *Fawler*.

Names showing a Sense of Beauty

Definite appreciation of æsthetic considerations is shown by the use of the Anglo-Saxon *faeger* (= fair) in names like *Fairford* and the not uncommon *Bright-* in names like *Brightwell*, descriptive of a sparkling spring. Any suspicions that we might have that the first element was a Saxon personal name *Bright* are happily removed by the Latinising of the name in a Saxon charter as *ad declaratam fontem* (at the bright well). So also we get the Anglo-Saxon adjective *myrig* (= merry), "pleasant" in *Merrils Bridge* (Notts) and *Moralhirst* (Northumberland), in both of which the first element is Anglo-Saxon *myrige hylde*, i.e. "pleasant slope," a phrase which is closely paralleled by a *faeger hylde ford* in a Saxon charter.

The frequency of the river-names *Blyth* and *Lyde*, which Dr. Ekwall has shown us are nothing but the adjectives *blithe* and a lost adjective *lyde*, a derivative of *loud*, would seem to show that our forefathers were not quite insensible to the cheerful sound of a running stream.

The great frequency of names in *Broom*, whether used by itself or in compounds (usually as *Brom-*), would suggest that they found delight in a golden patch of broom, and similar delight in an English hedgerow is suggested by the large number of names in *Hep-* and *Hip-* which go back to the Anglo-Saxon *heope*, a "hip" or "dog-rose." Close observation of nature is suggested by *Lemmington*, earlier *Lemeke-ton*, i.e. brooklime farm, in Northumberland, and *Gomer* in Hampshire, earlier *Galmore*, which is really the "swamp where the *gale* or bog-myrtle grows." It is curious to note how often a name in *-well* contains as its first element a bird-name, ranging from the *crane* in *Cranwell* and *Cornwell* and the *crow* of *Crowell* to the tiny wren and throstle found in Saxon names which unluckily do not seem to have survived to modern times. Such names indicate careful observation of nature, and many other examples might be given. Attempts to show that in these names we are really concerned with persons named *Hawk, Crane, Crow* and the like break down entirely, at least so far as the material goes back to Saxon times, for animal-names are extraordinarily rare then. The trick of nicknaming a man from some bird or beast was first taught us by the Vikings and does not begin to show itself to any appreciable extent until the latter part of the tenth century.

The suggestion has been made that the French invaders of the eleventh century first taught us to have any appreciation for scenery, the ground for this being that many of the names of French origin in this country describe a pleasing prospect. This seems to be a very doubtful proposition. To me there seems to be a certain monotony about names of French origin. They hardly ever venture beyond the somewhat colourless epithets of *Beau-* and *Mal-*. There are many *Beaumonts*, two "fine headlands" (*Beauchief* and *Beachy Head*), a "fine brow" (*Beaufront*), two "fine deserts" (*Beaudesert*), two *Beaulieus* and a *Bewley*, a *Belvoir*, some "fine retreats" (French *repair*) disguised as *Belper, Beaupel, Bear Park*, and plainer as *Beaurepair*, a *Beauvale*, several *Belasis, Belsize*, and *Bellasize*, a *Butterby* which is really *Beautrove*, "beautifully found," and a *Beams* and *Beamish* which

go back to Latin *bellus mansus*. Opposed to these we have *Malpas*, "bad ford," an interesting successor to the earlier English name of "Deep batch" or "stream," *Malsis*, "the ill-placed seat." There is a nice touch of humour in the Essex *Beaumont* which replaces an earlier English "Foul pit." Even if we throw in *Hautbois*, *Montacute*, and *Egremont* it would seem that, from the point of view of picturesqueness and appreciation for natural detail, the French names mark not an advance upon, but a decline from, the native English standard.

Nick-names as Place-names

Finally we may deal with the question of the existence of names which in the sphere of place-names take much the place which nicknames do among personal names. They are not common and there is very little evidence for their use in Saxon times. So far as they find their place on the modern map they may be suspected to be of Middle rather than Old English origin, were very probably influenced by the more picturesque methods of naming prevailing among the Vikings, and were undoubtedly often in the first instance names of fields, which afterwards were extended to whole farms and the like. Of this type we may mention *Unthank* used of land which is "ungrateful" towards its cultivator, *Snapegest* or "Snub-stranger" which may have been of similar import or was possibly applied to a farm where vagabonds received no friendly welcome. For many of the most picturesque names no early forms are found, and exhaustive study of the history of such in two English counties convinced the present writer that many of them were created out of nothing, so to speak, somewhere about the middle of the eighteenth century and onward. Names like *Glororum*, used of a commanding situation which "glowers" over the neighbouring country, *Make 'em Rich*, used of a prosperous farm, *Click 'em in*, a common inn-name, *Peep o' Sea*, used of a farm with a glimpse of the sea, are self-explanatory, and one would be wrong in these names or in such a name as *Pity Me* to fancy that these strange names hide, as has been sometimes suggested, some long-lost and well-concealed British name.

BIBLIOGRAPHICAL NOTE

In the above article all interpretations of names are based upon a study of their earlier forms, and no theory is based on names for which we have only modern forms. At the present time there is no general book dealing with the problem of the types and varieties of English Place-names, but the *Introduction to the Survey of English Place-names*, to be published some eighteen months hence by the *Survey of English Place-names*, will deal with many of them. At the present time the book which gives the best picture of modern tendencies in the interpretation of place-names is that on the *Place-names of Lancashire*, by Dr. Ekwall, published in 1922 as a volume in the Chetham Society's Publications and also as a separate volume by the Manchester University Press.

Ball Games in Ancient Greece

By Stanley Casson, M.A.

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Early in February last year a discovery was made in Athens which will rank as one of the most remarkable finds of Greek sculpture ever made. In a fragment of the city wall on the west side of the town, near the so-called Theseium, two statue-bases were found built up into the wall. Each measured approximately 80 centimetres square and some 30 centimetres in height, and was of fine Pentelic marble. In each case three faces of the bases were adorned with sculptures in fine low relief; the upper surface showed the sockets for the insertion of the feet of a statue, and the lower surface a square dowel-hole for the insertion of a foundation dowel. The bases had, in all probability, formed the summit of some rectangular foundation structure.

A third basis of exactly the same type, but with only one face decorated, was also found embedded in the same stretch of wall, but in this case the decoration had been in paint and there had been an inscription. Both painting and inscription had been deliberately defaced in the days of antiquity.

Scenes of Athletic Life

The first two bases were decorated with scenes descriptive of the athletic life of Athens. All three have been published.[1] The purpose of this article is to examine the meaning of one face of one of the bases only, since the general meaning and description of the reliefs has already been given in the various publications that have already appeared.

The base in question has on the left side a relief showing six young men standing in different positions which are all vigorous and active. All the men are naked, but their hair is carefully and neatly arranged in short curly locks except in the case of the man on the extreme left, whose locks hang loose over his shoulders.

The central of the three reliefs shows two men wrestling and two others standing near, one apparently keeping the ring and in a position to prevent the wrestlers from pushing each other beyond its limits, the other standing ready with a measuring pole to judge the distance of a throw.

[1] In *Journal of Hellenic Studies* (1922), p. 104, and *Bulletin de Correspondance Hellénique* (1922), p. 1, by A. Philadelpheus, and in *Dedalo* (September and December 1922) by A. Della Seta.

The right relief shows a quieter scene in which two youths sit on chairs and hold on leashes a dog and a cat respectively on the left and right of the centre. Behind the chairs on each side another youth is leaning, looking on. Each of the figures is clothed in a long garment.

The relief which seems most difficult to explain, and which in fact has not been explained, is that above described first as on the left side of the base. The six athletic figures have been accounted for in various ways as dancers, as athletes each representative of a different form of athletics, and as ball-players. No definite attempt, however, has been made in the last case to ascertain what type of game they are playing, whether a team game or one in which only one at a time can play, and whether the game corresponds to any of the known "official" games of public festivals, or whether it is one of the ordinary games of every-day life in the palæstra.

A close study of the relief itself shows that the players are grouped round an imaginary central line which divides the relief into two equal parts. The three men on the left seem to be advancing, those on the right retiring. The six thus form two teams of three. The foremost on each side is moving at a moderate pace, the central figures at a faster pace, and the figures at the back of each team at a slow pace, almost a walk. To use modern "Rugby" terms, they might be called "forwards," "three-quarter-backs," and "full-backs." The team that appears to be advancing has possession of the ball, which is a small one and is held in the hand of the full-back.

It remains to be asked, then, whether there is any record of any such game in literary or other sources in the ancient world.

The solution seems to me to be given in a passage in the well-known work of Julius Pollux called the *Onomasticon*, a work which might be described as a "young man's guide to university life." This work is dedicated to the Emperor Commodus and, in consequence, must have been published shortly before A.D. 177. It is written in Greek and is concerned largely with things Greek. Its author had studied at Athens in the university, and can, therefore, be considered as in some ways an authority upon Athenian life in the days when old traditions were being revived.

In the ninth book of the *Onomasticon* one section is devoted to games, both of children and of young men. Four games of ball are mentioned—*Phaininda*, *Aporraxis*, *Urania*, and *Episkyros*.

The Athenian Form of Rugby

Episkyros is the only team-game mentioned in which a ball was used. It was a "ball-contest" (*σφαιρομαχία*) rather than a "game" (*παιδιά*) for individuals. According to Pollux it was played by young men rather than by children. The players were divided into "two teams of equal numbers facing each other or separated by a central chalk-line." This chalk-line, or "half-way" line, in the language of Rugby, was called the *skyros*, another word for chalk. The ball was placed on the central line, as in a "kick-off," before the game began. There were two other lines drawn behind the central lines that seem to correspond to the "twenty-five" lines of Rugby football, but they were used in the same way as the "back-line," and formed the back limit of the area of play. The game presumably started by the ball being seized by one side or the other and thrown in the direction of the opposing "back-line." The team that held the ball had to avoid being pushed over the "back-line."

The description is brief and summary and many essential details are omitted. We are not told how the game starts, nor whether the players of one team are allowed to pass the ball from one to another, nor what precisely constitutes a win. Probably the team that held the ball had to get rid of it as soon as possible by throwing it in the direction of the opposing goal, and following up with a charge which would hustle the opposing team over their own "back-line" before they had time to get rid of the ball themselves. In any case the main point of the game seems to have been to avoid keeping the ball, since the team that held it was at a disadvantage: in this respect the game differs from our own games of football. The description given by Pollux is short and condensed, chiefly because his work was a dictionary packed with condensed information and not an explanatory treatise. At the same time it seems doubtful if he really understood the game he was describing.

This game of *Episkyros*, or "the chalk-line game," seems to explain our relief. Here we have two teams of equal size divided by a central line. The team on the right has just thrown the ball, which has been caught by the full-back of the opposing team and is being thrown back before the attacking team has time to charge. The team in possession of the ball is, in its turn, preparing to follow up the throw of its own back by a charge which may succeed in hustling the opposing team over their "back-line." The full-back who holds the ball is just about to launch it in the direction of the other team: his "outside" or "three-quarter" is preparing to follow up at full speed, while the "forward" is advancing judiciously so as to fall back as a defence in case the opposing team counters the move by throwing the ball back again quickly. It is evident that the team which *catches* the ball is in a position of advantage over the team who have to *pick*

it up from the ground, since in the former case the ball can be thrown back as soon as received. The main function of the "full-back," then, is to be able to catch and to throw.

In the team that is retiring the same division of duties can be detected. The "forward" is retiring cautiously, ready to advance again. The "three-quarter" is alert, ready to move in any direction, and the "full-back" is waiting to catch the ball and throw it back. In addition, the "full-back" seems to be the captain: his left arm is extended as though he were signalling to the "forward" to fall back. It is, I think, no mere coincidence that his gesture corresponds to the modern Greek equivalent of our own gesture of beckoning. The hand is turned down and makes a sweeping downward motion.[1]

The general correspondence of the sculptured scene with the game described by Pollux thus seems evident. No element of the game as described by Pollux contradicts what we have in the relief. On the other hand, we learn from the relief much that seems to supplement what is in Pollux. Thus the division of functions of the players, the counter-throw of the team that has received the ball, and the important position of the "full-back," who acts both as captain and principal defender, are points which are not indicated by Pollux but which yet agree with his account.

Other Greek Ball Games

A few general considerations need attention. Of ball games in general we know little outside what Pollux tells us. The second of the newly discovered bases shows us a ball-game hitherto unknown, resembling hockey. From inscriptions in Sparta comes much evidence as to the contests of teams of ball-players,[2] but unfortunately there is little to enable us to tell the nature of these Spartan games.

It is, of course, possible that Athens derived many of her non-Olympian games from Sparta itself. The games of the everyday life of the palæstra, called by the Greeks παιγνίαι, were said by the Lydians to have been learnt by the Greeks from Lydia.[3] Lydia, we know, was in the closest possible touch with Sparta in the seventh and early sixth centuries B.C., and it seems probable that Sparta was the home of the ordinary athletic game. The game of *Episkyros* certainly falls into the category of a παιγνία. It was also called *Ephebike* or *Epikoinos*, Pollux tells us—the first because it was a game rather for young men than for children, the second because a moderately large number of players took part in it.

FIG. 1.—THE ANCIENT ATHENIAN EQUIVALENT OF RUGBY.

That the game should have originated in Asia Minor seems still more probable in view of the fact that the date on grounds of style of this relief is shortly before the year 510 B.C., when the Ionian artistic and other influences originally imported to Attica by Peisistratus were the ruling fashion. This Ionian predominance in fashion would have sanctioned the adoption of a game from Sparta which was already known to the Ionian elements of the population who had come over to Athens as artists, students, and athletes.

As a work of art this relief is one of the most remarkable and beautiful of the archaic period ever found in Greece. The darkness of the background that is evident in the photograph is due to the fact that the original crimson colouring is admirably preserved. The elegance, perhaps at times slightly exaggerated, of the

[1] I am indebted to Professor J. L. Myres for this suggestion.

[2] See M. N. Tod in the *Annual of the British School at Athens*, vol. x, pp. 43 ff.

[3] See Herodotus, i. 94.

figures and the variety of their attitudes show at once the vigour and the capacity for experiment which was so characteristic of the Ionian art of Attica at this period. The back view and the foreshortened drawing of the feet of the captain of the team on the right provide us with one of the earliest examples in sculpture of this artistic initiative which was so characteristic of the period.

It may be objected that Pollux was hardly in a position to know anything about the games that had been played in Athens in the days of Peisistratus. But it must be remembered that games die hard: the urchins of Rome still play the games that were in vogue in Imperial times. There was, further, something in the nature of a revival of the old university life of Athens at the time that Pollux was there; even if *Episkyros* had not been revived as a game, there would probably have been men who knew well enough what the game was.

The relief which shows the so-called "Hockey-players" involves no serious problem of interpretation beyond that of the precise name and nature of the game, if one can be found. The scene is simple and straightforward. Two naked athletes in the centre of the field bend down, each holding a hooked stick, which, to judge from the proportions it bears to the bodies, must have been some two and a half feet in length. Behind these central figures on each side are two other players standing in attitudes of rest, all except one holding similar sticks. The one exception holds his hands in an attitude of one holding a wand, but there are no traces of either a metal fixture or of a painted wand, and it is difficult to see how, if painted, it could have been rendered, since the surface of the marble is broken by the two projecting arms of the two figures so that it would be impossible to paint a straight line upon it.

The attitude in detail of the two central players is curious. Each holds his stick by a grip well up the shaft and not at the end. The player on the right holds it in his right hand and places his left hand almost, but not quite, upon the butt of the stick. The other player uses his hands in the same way, but with the right hand as the playing hand. The ball lies between the two sticks as though in position for a "bully."

The game, to judge from the evidence of the relief alone, is one for two players and not for a team. The players at the sides seem to be spectators waiting their turn. Perhaps there were two teams, each consisting of three players, who played in individual combat, the game being thus decided on points.

FIG. 2.—THE ANCIENT ATHENIAN EQUIVALENT OF HOCKEY.

The name of the game has been fixed, almost with certainty, by the Greek archæologist M. Oekonomos,[1] of Athens. He finds, in a passage in Plutarch,[2] a reference describing a statue of the orator Isocrates. The statue represented him as a boy, was of bronze and stood on the Acropolis at Athens in an enclosure called the "Sphæristra of the Arrhephoroi." The Arrhephoroi, we know, were the two attendants who acted as priestesses or officials in the Panathenaic and other processions. Their dwelling is usually identified

[1] In the official Greek journal Δελτίον Ἀρχαιολογικόν, 1922, pp. 56–9.

[2] *Lives of the Ten Orators*, ch. 4.

on the north side of the Acropolis near a steep postern stairway. The "Sphairistra," which can only mean a "court for ball games," must have been near at hand. Plutarch describes the statue as κερητίζων, a word which has been rejected by the editors of the text because no meaning could be found for it: its manuscript authority, nevertheless, is excellent.[1] It has been emended to read κελητίζων, which has the straightforward meaning of "riding a horse," the statue thus being equestrian. M. Oekonomos, however, retains the earlier reading κερητίζων and, from the connection of the word with κεράς, "a horn," he derives the word which gives us the name of the game—a "game played with horned sticks," or, if you like, the "game of hook." It is noteworthy in this connection that the place in which the statue of Isocrates stood was a "court for ball games," and, further, that the attitude of the central players on our relief is that of hooking and not of striking, as in hockey.

The style of this relief is very greatly different from that of the first. It is by an inferior artist who was not successful at unusual attitudes. He has failed to render the grace and agility of the bending figures, though he is more successful with the standing. The figure on the extreme right, however, is clumsily outlined. From a comparison of the faces of the figures—the most conventional part about them—with coins of Athens bearing the features of Athena of the early fifth century, it seems most probable that the relief belongs to a period about 495 B.C.

[1] It occurs also in the lexicographer, Hesychius.

Filter-Passers

By R. J. V. Pulvertaft, B.A.

The great fascination of science and discovery lies in the search for that far-off shore where is attained the final and indivisible truth—the last, remotest star, the western continent, or the tiniest morsel of life itself. It seemed to the pioneers who first sighted the bacteria—those minute fungi, distant cousins of the breakfast mushroom—that they had attained their goal, and that Life could not live in narrower confines. Yet to-day we hear of living creatures far smaller than most bacteria, but of even greater importance in the havoc they work to the human race. To this group of living morsels has been given the name of "Filter-passers," and, although they have baffled research from the time of Pasteur to the present day, it would seem that now at last we are beginning to understand more about them.

Let us consider the diseases believed to be caused by them first, and then discuss the methods used to get into touch with them. First, and most important in its universality, we have influenza; small-pox, hydrophobia, scarlet fever, and measles are among the commonest of diseases throughout the world of man, and are attributed to the same group of organisms. Foot and mouth disease is one representative of the damage they do to the animal world, and distemper in dogs another. Even the plant world suffers from them. For instance, mosaic disease in tobacco plants ruins many crops yearly. We notice that all these diseases are very infectious—infinitely more so, for example, than the bacterial disease typhoid fever, which can only be contracted by eating infected material or injecting bacteria. We get the impression that there must be a deadly mist arising from an influenza patient—that the tiny creatures which cause it must float like clouds of smoke through the air. That fact alone would serve to incline us to the belief that the fatal organism, whatever it be, is very tiny.

The Size of Filter-passers

Its size is further emphasised by the property from which it has derived its name—the power of passing through a filter. The filters used by the careful housewife to purify her water supply, and by the bacteriologist to rid the fluids, with which he works, of bacteria, are of two kinds. The Berkefeld filter is made by compressing an earth which consists of the flinty skeleton of a microscopic plant known as a diatom—an earth which is also used as a knife polisher and a tooth-powder. The solid mass formed by this compression has little pores in it, and we can readily believe, from the nature of it, that these pores will be of various sizes. It has been estimated that particles as large as a five-thousandth part of a millimetre—$\cdot 2\ \mu$ in the language of the bacteriologist—can pass through the filter in some instances. The second kind of filter is the Chamberland—it is made of unglazed porcelain, and has much smaller pores. Perhaps we should not be far wrong in assuming that any particle which passed through it must be smaller than a fiftieth part of a μ.

Every filter-passer can pass through a Berkefeld filter, some can negotiate a Chamberland, and one has been described—the organism responsible for mosaic disease in tobacco plants—which is even said to be able to diffuse through gelatine. It seems, however, in a high degree unlikely that particles so minute as to diffuse in that way can really be alive at all.

But even a particle a five-thousandth part of a millimetre in size is far too small for us to imagine. The tiniest drop of human blood contains seven million red blood cells, and each of these is more than thirty times

as big as the biggest filter-passer. We can, however, see bodies as small as six-millionths of a millimetre by appropriate means. When we look through an ordinary microscope, we see objects as black specks on a bright background—some of the rays of light from the reflecting mirror are obstructed by the object looked at. An alternative method is to transmit the light at an angle through the liquid examined. In that case every little particle will reflect rays of light to our eye, and we will see the object as a bright speck on a dark background. It is by this method that we can see the smallest objects yet described, and it is obvious that a filter-passer is a giant compared with the particles that may be seen.

Filter-passers, then, are not too small to be seen. The trouble is that when a fluid, such as a nasal secretion from a dog with distemper, is looked at by these special means, so much is visible that it is not possible to distinguish the filter-passer from other unimportant particles.

Even a bacterium is not easy to identify if examined in a state of nature. It must first be " stained " with aniline dyes ; and the aniline dyes themselves consist of relatively large particles. Staining filter-passers has therefore not proved helpful—the particles of dye and the organisms themselves are too nearly of the same size.

In spite of these difficulties, many claims have been made that filter-passers have been both seen and identified. In some cases—notably in measles—a tiny bacterium, 2μ in diameter, is described from America. Again, in the pneumonia of cows a bacterium is shown to pass a filter, and to be associated with the disease. We see, therefore, that at least in some instances the fact that the organism of a disease passes a filter does not show it to be of necessity other than a bacterium.

On the other hand, in distemper, influenza, and rabies, to mention only a few diseases, the objects seen do not resemble bacteria. They are tiny specks—that is all that can be said of them.

Are Filter-passers Alive ?

We must now turn to a rather important question. How do we know that these little objects are alive ? And if alive, how can we be sure that they cause the disease ? It is probable that the answers to these questions would not satisfy everyone. Bernard Shaw, in the preface to *The Doctor's Dilemma*, thinks it possible that all bacteria may be only symptoms, and not the cause, of disease. It is worth while to spend some time in the consideration of the reasons given for a belief in the life of a filter-passer, and its relation to disease.

Life is always difficult of definition. But one very significant property of living matter is its power of reproduction. It is on the establishment of that feature in filter-passers that the whole theory of their nature rests. It is not enough to say that if we filter a nasal secretion from a sick man, and then inject it into another living creature and produce similar symptoms, we have proved that there is a living organism in the filtered fluid. All bacteria produce poisons as they carry on their business of living ; these can be filtered off and will produce severe symptoms. But if, having produced symptoms, we can filter off another fluid, and produce symptoms again in this third animal, and so on many times over, we must come to the conclusion that an organism is reproducing itself on each occasion in the body of the patient. No bacterial poison could produce symptoms after dilution to many thousand times its original volume, and this dilution is involved in the process described.

Artificial Culture

Again, if we can grow the filter-passer, take a tiny morsel of the growth, and grow it again and again on suitable soil, we can prove that it is reproducing itself and is alive. Both these processes have been carried out with many filter-passers. But very special methods must be adopted to cultivate a filter-passer in a test-tube. It will only grow out of reach of the air ; only in special fluids, and only if a piece of rabbit's kidney, or another organism, be included in the tube. Volpino, an Italian scientist, has grown the filter-passer which causes cow-pox by growing a harmless bacterium with it. Noguchi, a Japanese bacteriologist, was the first to grow a filter-passer, in 1913 —the organism of infantile paralysis. The influenza filter-passer has been grown in America, in England, and in South Africa, and at one time or another many other successful attempts have been reported. There have been many failures too. Even Polar bears cannot rear their young in captivity ; the leprosy bacillus has never been grown, and so we cannot be surprised if filter-passers, too, do not seem to love unnatural surroundings. They wilt and die, like rare orchids.

Do Filter-passers Cause Diseases ?

When Koch, the great discoverer of the tubercle bacillus and the father of modern bacteriology, first described his success, he laid down the law that in order to establish a definite relationship between an organism and a disease, the organism must be discovered in the body of an animal into which it has been injected, and which has suffered, as a result, from the disease. This has proved very difficult in many bacterial diseases. Leprosy has never been successfully transmitted in this way. It is doubtful whether scarlet fever, in spite of many attempts with human

beings, has been transmitted. Even influenza, in spite of the American claims which have lately been widely published, is still on the doubtful list. Many believe that a bacterium called after Pfeiffer is the real culprit. But filter-passers offer a very special problem, since in two instances—in small-pox and in hydrophobia—instead of the tiny filter-passer, much larger bodies, known as the Guarnieri bodies and the Negri bodies respectively, are found in the organs of the dead animal after injection of a filter-passer. They are too big to pass a filter; we shall return to them later, and see how they may be related to the filter-passer.

For the moment we must remember that bacteria are not the only creatures whose presence in the human body brings disease and death. The protozoa form another group, the first and tiniest animals, as the bacteria are the first and tiniest plants. Malaria is a type of a protozoal disease. These little animals have a life-history; unlike bacteria, which exist only as spores or adults, we can parallel in them Shakespeare's seven ages in man. And it is possible that some filter-passers are protozoa, not bacteria. Many protozoa can, at some stage in their history, pass through a filter. It has been stated—and, as in the case of nearly every statement which can be made on this difficult question, it has been denied—that the protozoon found in sleeping sickness can pass a filter during some of its stages. And when we come to examine the reports of those who claim to have grown a filter-passer in a test-tube, we find that they are not identical. In some instances, as in infantile paralysis, the familiar tiny, nameless speck is seen. In others—notably in Noguchi's description—an oval object, with a central body or nucleus, was seen. Such a description is unlike a bacterium, but very like a protozoon. And then we find the Negri body—a group of tiny specks in a surrounding envelope—in the brains of dogs dead of hydrophobia. That may be another stage in the filter-passer's history. And another fact is very suggestive. How is it that by giving a man cow-pox—a distinct disease as far as symptoms go—we can excuse him from the necessity of having small-pox? Such a state of affairs is unique in medicine. The suggested answer is that cow-pox is caused by one stage of a protozoon; small-pox by another. Variation in the stages which protozoa achieve in different animals is well known—even in malaria the parasite is in a different stage in the mosquito and in man.

Some Special Filter-passers

It is pleasant to relate that filter-passers are not always our enemies. A remarkable theory is put forward by D'Herelle. He believes that he has found a filter-passer which lives, like a parasite, on bacteria. He calls it the Bacteriophage, or Bacterium-eater. Space will not permit of a full description of this last example of the law that "Big fleas have little fleas upon their backs to bite 'em," but it has obviously a very important bearing on the question of immunity to disease.

To make our survey, brief though it is, more complete, we must mention the question of malignant growths such as cancer. It has been stated that warts are caused by filter-passers, and warts bear considerable resemblances, from the pathologist's point of view, to cancers. It is well established that a form of cancer in birds and dogs is related to filter-passers. Many years ago large bodies called "Russell's corpuscles"—a harmonious phrase—were described in malignant tumours, and might be compared to the Negri bodies of hydrophobia. But, obscure though the cancer problem is, it is not probable that the solution will come from a study of filter-passers—and "Russell's corpuscles" have long been discredited.

It will be interesting to await the results of the present concentrated attack on the question of distemper in dogs, and its relation to influenza in man. Perhaps in a very short while we may see this whole question on a far more secure basis than it is at present.

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Modern Industries

I. CEMENT MANUFACTURE ALONG THE HUMBER

By R. C. Skyring Walters, B.Sc., Assoc.M.Inst.C.E.

The object of this paper is to describe the cement-making industry in the North Lincolnshire and South Yorkshire coasts bordering on the Humber estuary.

The raw materials required for the manufacture of cement are those containing 75 to 78 per cent. of calcium carbonate (obtained from certain chalks or limestones) and the balance (25 to 22 per cent.) of silica, alumina, and iron (a constituent of shales, clays, or muds), and the most successful works are those which are situated near both these materials and which can easily obtain good supplies

of coal or coke, with adequate transport facilities for sending away the finished product from the works.

The usual method is to burn chalk containing the necessary calcium carbonate with the clay in cylindrical kilns, upwards of 200 ft. long, which slowly revolve. The kilns are *inclined*, enabling the mixture of chalk and clay, which is well pulverised and made into a liquid paste called "slurry," to travel slowly down the kiln. At the lower end, a blast of coal-dust is blown in, which immediately catches fire and burns the on-coming slurry to hard grey nodules of varying sizes up to a man's fist. The nodules, if suitably burned, are ground and reground to a powder so fine that, in order to qualify for the British Standard specification, 86 per cent. of it must pass a sieve with 32,400 meshes to the square inch. In this state it is the finished Portland cement. At Barton the cement is ground so that approximately 97 per cent. passes this sieve. The whole process is, at the present day, carried out in the most scientific manner; several chemists are employed in a large establishment. This ensures the product being not only good, but *invariably* good. In the old days, when the manufacture was carried out by rule of thumb, the resulting cement was very unreliable.

The silica and alumina in the clay combine with the lime in the chalk. The compound of the greatest cementitious value is believed to be tri-calcium silicate; therefore, if the percentage of calcium carbonate gets too low, too much bi-calcium silicate is formed; whereas if it gets too high, there is too much free or loosely combined lime present and the cement will be unsound. The general rule is that the higher the percentage of lime, the higher the strength of the cement; but such factors as the fineness to which the raw materials are ground and the correct temperature of the kilns are most important In a kiln one attempts to arrive at what is called incipient fusion.

Modern methods of cement manufacture therefore ensure a cement of uniform quality from a particular establishment and have enormously increased the use of all kinds of work in reinforced concrete, such as bridges, retaining-wells, reservoirs, factories, warehouses, floors, and such things as seats, sign-posts, signal-posts, which it is now becoming very common to make of this material.

FIG. 1.—HESSLE QUARRY.
Output of chalk, with two diggers operated by five men in all, totals 5,000 to 6,000 tons per week.

The Humber-side possesses all the natural advantages for manufacturing a first-rate Portland cement. The calcium carbonate is there on both sides of the river, in cliffs, some 200 to 300 ft. high, which constitute the high ground known as the Lincolnshire and Yorkshire Wolds. They contain some of the largest chalk-quarries in the country. The necessary clay lies at the foot of these cliffs in the form of river-mud, probably deposited

by the Humber. (It is scarcely probable that any of this should be of glacial origin, that is, deposited by the melting of the glaciers that are known to have once covered these regions.)

The necessary coal is brought by the cheapest of all methods of transport, water, from the neighbouring Yorkshire Coal-field to the works situated by the water-side and, lastly, the finished product can be readily sent away from the works or exported from the neighbouring ports of Hull, Immingham, and Grimsby.

Very few fossils have been found in the immense pits excavated, but a few ammonites, fish-teeth, and echinoids, popularly called "fossil-mushrooms," have been unearthed. The chalk is won by pick and shovel; holes are "jumped" and blasting is resorted to, charges being inserted at or near the floor of the quarry; and these, when exploded, generally bring down a portion of the whole of the vertical cliff face. Occasionally men work, where it is safe, on ledges half-way up or near the top. In the quarry illustrated in Fig. 1, where mechanical diggers are

FIG. 2.—THE NEW CHALK QUARRY NEAR BARTON-UPON-HUMBER. Showing method of working in foreground, and the Cement Works and River Humber in the background.

in use, 5,000 to 6,000 tons of chalk are dug per week, the men actually employed on these being five in number.

The chalk is loaded into trucks, as shown in Fig. 2, which are taken by a steam locomotive to the works just discernible on the left-hand side of the picture, which shows also the Yorkshire coast-line on the other side of the Humber. The flint is picked out into heaps, also shown in the photograph, suitably loaded into trucks and taken away for road-metal.

The floor of this quarry has the great advantage of being dry, as it is slightly above the low-lying ground in the vicinity of the Humber. This enables the quarries to be worked in comfort and saves the great expense of pumping which in some places is needed. The clay is dug in a large but shallow pit in the low-lying ground between the quarry and the works as shown in Fig. 2.

On the Yorkshire or northern side of the estuary is perhaps one of the most recent establishments laid down in the country for the manufacture of cement. Here the chalk is dug three miles away inland, where there has been erected a plant to crush it and make it into slurry. In this form it travels through some three miles of pipes to the works situated on the Humber side. It is conveniently placed in proximity to clay deposits, similar to those that occur on the South Ferriby side, and it is well situated as regards transport facilities.

NOTE.—The writer wishes to thank Mr. A. N. Earle for much of the information embodied in this article.

Reviews of Books

NEW LIGHT ON THE WANDERINGS OF THE CELTS

The Bronze Age and the Celtic World. By HAROLD PEAKE, F.S.A. (Benn Bros., 42s.)

The later stages of the prehistoric period—Neolithic, Bronze, and Iron—afford no sensational evidence of man's past, such as we are accustomed to expect from discoveries of the Palæolithic or Early Stone Age. Yet the restricted attention which these periods receive is due to no lack of interest in the subject-matter. It is to be attributed rather to the fact that, with few notable exceptions, writers on the subject, if they have appealed to a public wider than the specialists, have been content to give a general view of the culture of each period as a whole, but have not dealt on broad lines with the more general problems of racial history which underlie the study of prehistoric culture and give to archæological investigation both its bearing and its perspective. It is an outstanding merit of Mr. Peake's study of the Celtic problem that, while the main foundation upon which the whole structure of his argument rests is of a highly technical character, its detailed discussion is not allowed to assume disproportionate prominence and its relation to broader problems is never forgotten. In fact Mr. Peake's lucidity and breadth of treatment are such that even those unversed in the technicalities of the subject may follow his argument and earn both profit and enjoyment from their reading of the book, even though they may fail to appreciate the immense amount of research and the imaginative handling of detailed evidence which have gone to its making.

The Celtic problem has at one time or another attracted much attention from both archæologists and philologists. The Celtic language presents peculiarities in structure and vocabulary which mark it off from its sister tongues of the Aryan group, and belong to a non-Aryan language such as, possibly, the now extinct Pictish. It is spoken only by peoples living on the north-western fringe of Europe—Wales, Scotland, Ireland, and Brittany, and, up till comparatively recently, Cornwall and the Isle of Man. The people who speak it belong to the short brunette type called by anthropologists the Mediterranean race. These people are popularly known, particularly to

the daily Press, as the Celts, but it is an important factor in the problem that in classical times the Celts were described as tall, fair, and light or blue-eyed. Further, it is known from the accounts of classical writers that the Celtic language in the century immediately preceding the Christian Era had a far wider distribution than it has to-day, and was the language of all Europe west of the Rhine and north of the Pyrenees and the southern slope of the Alps, including the Alpine zone of Central Europe as far as a line Agram–Cracow and, possibly, at one time farther east. The Galatians of Asia Minor, to whom the Epistle of St. Paul was addressed, were an offshoot of the Celtic race. The problem, then, to which Mr. Peake has addressed himself in the light of anthropological, archæological, and philological evidence is the origin of these peoples and the date of their intrusion into those areas in which they were found some two thousand years ago. Mr. Peake accepts the view that, on the evidence of our classical authorities, the Celts were tall and fair and that they are to be identified with what is now known as the Nordic race. This race, with the broad-headed Alpine and the dark, long-headed Mediterranean type, made up the population of Europe at the dawn of the Neolithic or later Stone Age Period. The Alpine race came into Europe from Asia, while the Mediterranean race had descended from one or possibly more of the types of man of the last phase of the Palæolithic Age. The Nordic race remains to be accounted for. Mr. Peake suggests a descent from Solutrean Man—the man who lived in the last period but one of the full palæolithic period, when climatic conditions produced broad open plains, suited to the life of nomad hunters—a mode of life very different from that of the comparatively sedentary Aurignacian and Magdalenian cave man who preceded and followed Solutrian Man. At the beginning of the Magdalenian period a change in climate is accompanied by the disappearance of the Solutrians. Mr. Peake suggests that they withdrew eastward, and on the steppes east of the Dnieper, perhaps ranging as far as Turkestan, gave rise to the culture of the Kurgans or burial mounds of Southern Russia—a culture of which in this connection the chief interest is that it is that of a race of nomad hunters. In these people Mr. Peake finds the beginnings of the Nordic race, and interprets the somewhat puzzling archæological evidence of this area and period as indicating a series of expansions or migrations which led them to overthrow neighbouring civilisations, such as that of Tripolje in South Russia and Anau in Turkestan, and, finally, about 2200 B.C., to occupy the Hungarian plain. Another branch of this migratory movement reached Mesopotamia and ultimately was responsible for the Cassite domination in that area about 1700 B.C., and again another brought about the destruction of the second of the six cities found on the site of Hissarlik (Troy).

Before turning to the later wanderings of this people, it is desirable to indicate a little more in detail the kind of evidence upon which Mr. Peake's inferences are based. It is briefly that of type and distribution. A particular class of evidence is taken, as Mr. Peake has taken the leaf-shaped sword of the Bronze Age, and the relation of the various types to one another is studied and classified in a series of development. The distribution of the types is then plotted on the map. This method of study, of which the possibilities are only just beginning to be appreciated, has already proved most fruitful. No better example of its merit need be sought than the results it has yielded to Mr. Peake. The chapter on the commerce and trade routes of the Neolithic and Bronze Ages will repay close attention from this point of view. In the case of the leaf-shaped sword, so called from the shape of the blade, which is classified into seven types, the author is able to show that it developed from the Mediterranean bronze dagger in the Hungarian plain, whence it spread over the greater part of Europe. One of two found in Egypt is engraved with the name of Seti II, thus giving a definite date for its type. Treating it as the characteristic weapon of the Nordics, Mr. Peake infers from its distribution the wanderings of this race, dating them by type, and shows how they advanced against the less aggressive agricultural races, as, for instance, the Alpine peoples of the Central European mountain zone, and established themselves as overlords. These leaf-shaped swords have been found in Greece, Italy, Central Europe, the Baltic, Gaul, Britain, and Ireland. In each case Mr. Peake's theory of the intrusion of a wandering adventurous element seems to fit in with what we know of the prehistory and early history of these various parts of Europe, and serves in some cases, as in Greece and Italy, to afford valuable assistance in elucidating their special problems.

In the case of Britain, Mr. Peake concludes that the course of events was rather different. An early infiltration of these races was followed by a later and extensive immigration. The association in this country of bronze agricultural implements with a late type of leaf-shaped sword, points, he thinks, to a wholesale exodus of overlords and subject population from Central Europe. This exodus was probably caused by a later wave of Nordics from the Hungarian plain who had acquired the use of iron, possibly from the Caucasus. In any case, whatever may have been the cause of the migration, the Nordics would appear to have imposed their own language on the population of Britain so effectually as practically to have caused all but a few traces of the earlier tongue to disappear.

Mr. Peake's view thus agrees in the main with the conclusion of Sir John Rhys, at which he arrived on philological grounds, that the British Celts represent two separate waves of migration from Central Europe.

It has not been possible to deal with Mr. Peake's system of dating, nor with his examination of the linguistic evidence and of the Aryan problem, important as these are in support of his argument, nor has it been possible to do full justice to his handling of the innumerable controversial questions ranging from earliest Palæolithic times down to the Iron Age, upon which he touches. As an exposition of the broader problems of prehistoric archæology, Mr. Peake's book stands alone. *The Bronze Age and the Celtic World* is, indeed, a work upon which the author is to be congratulated.

E. N. FALLAIZE.

The Measurement of Emotion. By W. WHATELY SMITH, M.A. (Kegan Paul, 10*s*. 6*d*.)

It has been known for some time that the resistance offered by the human skin to the passage of a faint electric current varies sharply with changes within the body, and in particular with the presence or absence of an emotional state ; this latter concurrence is known as the "psycho-galvanic reflex," and some rather distorted accounts of it have appeared in the daily Press.

In order to excite an emotional reaction for the purpose of studying it, a very convenient method is the word association reaction of Dr. Carl Jung, in which a number of words are called out, one by one, to the subject of the experiment, who is required to answer with the first word that comes into his head. Some idea of the emotion, if any, excited by the word can be obtained by consideration of the character of the answer and of the rapidity or delay in making it. Further information is obtained by measuring the disturbance produced in the galvanometric circuit in which the object is included, by calling out the word.

Mr. Whately Smith finds good reason for concluding that the electric disturbance is proportional to the intensity of the emotion, and by combining the very delicate and measurable psycho-galvanic reflex with the word association reaction (for the first time systematically and over a very large number of observations), he has obtained some extremely important results. In the first place he has made a contribution to pure psychology in throwing new light upon the nature of "affective tone" (the undifferentiated state behind the emotions that is elaborated into "pleasant" or "unpleasant" feeling) ; in the second place the findings made by the exact and quantitative galvanometric method have refined and made more reliable the word association reaction as an instrument of diagnosis—a matter of considerable importance to the practising psychologist. In the last chapter the author formulates a theory of the nature of emotion (or, more exactly, of "affective tone") that he has built upon the experimental results.

The theory postulates that we live continually in a state of inhibition, that is to say, our immediate impulses to action, which are naturally for the most part unconscious, tend to be subjected to a greater or lesser degree of repression or postponement. According to the author, an increase of this repression gives rise to a negative affective tone, and this, if we become conscious of it, to a feeling of discomfort. A decrease in inhibition gives rise similiarly to a positive affective tone and a feeling of "pleasure." From this we may deduce the somewhat melancholy conclusion that while there is scarcely a limit to pain and discomfort, happiness has a definite term—could it be reached—in absolute freedom. In connection with this dependence of pleasurable feeling tone upon freedom from constraint and conflict, it is perhaps worth noting the strong pleasurable feeling experienced in the typical dream of flying—a dream to which the Freudian school of psychology has given a somewhat narrow sexual interpretation.

Mr. Whately Smith's theory has a close parallel in many of the normal physiological processes of the body, which under ordinary conditions are kept stable by the balance of two opposing influences ; and the theory is completely congruous with the conception of man's psychological evolution along the lines indicated by MacDougal[1] ; and with Freud's theory of man's development from the "Pleasure-pain Principle" to the "Reality Principle."

Although *The Measurement of Emotion* is a book primarily for the specialist, yet it should prove of great value to anyone interested in psychology and familiar with the current theories ; while the precision of the author's methods, and the ingenious system of checking and controlling the results, form an object-lesson in psychological research and a contrast to the somewhat tenuous fabric upon which not a few modern psychological theories have been constructed.

F. A. HAMPTON.

Protein Therapy and Non-specific Resistance. By W. F. PETERSEN, M.D., with an Introduction by J. L. MILLER, M.D. (New York : The Macmillan Co., 21*s*.)

Twenty years ago a textbook of medicine was apt to give forty or more drugs as useful in one particular ailment. To-day, it rarely gives more than two or three ; a multiplicity of "curative" prescriptions always argues that all are futile to effect a cure or incapable of modifying a natural cure. This tendency arises in part from the recognition of a very few drugs which appear, quite definitely, to have a specific effect in particular conditions. Many of these drugs were used from antiquity—for example, zinc compounds are used to-day in certain eye conditions, and were used in ancient Egypt with equal success and equal ignorance as to the theoretical basis of their peculiar virtue. Some few are the result of laborious laboratory research ; others, such as quinine and digitalis, were country simples or native remedies before they were dignified by elevation to the Pharmacopœia. In all, the specific drugs—those that have a selective effect in curing one particular condition—are very few in number. But their existence has influenced medical opinion ; the search is always for a means of countering each individual foe with its single and appropriate weapon. If anyone needs further proof of this, let him compare the size of a hospital pharmacopœia—a book for the vest pocket and practical purposes—with the British Pharmacopœia—a book for the fireside, if not for the fire !

But the greatest single influence in this direction has come from the important work which Sir Almroth Wright and his numberless followers have done in establishing the principle of Vaccine Therapy. The method and its theoretical basis may be briefly outlined. Suppose that a bacterium has established itself in the nose, and we suffer, consequently, from colds in the head. Some of these bacteria are taken, and grown in a medium which is found suitable ; they are then killed, by heat or chemical means, and injected into the arm. Whereas, before, the infection, localised in one small part of the body, did not

[1] *Social Psychology.* (Methuen & Co., Ltd.)

call forth the armed hosts of the body's mechanism to defeat it, this artificial injection is capable of so doing, and we cease—if we are fortunate—to suffer from colds in the head.

The essential feature of this method was that success was believed to depend on the injection of the corpses of the particular bacterium causing the disease. More than that—although we might have a stock of bacteria in hand identical to all appearances with those in the nose, they might fail, while the actual bacteria taken as we have described would succeed.

This law of specificity seems universal in the mechanism of life. In the process of digestion, as in a hundred other vital processes, numerous "enzymes" are employed. These are mysterious substances, capable of bringing about great chemical changes, but strictly confined each to its own task. That is the reason why a new-born babe cannot digest starch, however much the patent foods for infant feeding may proffer it, for it lacks the specific substance which turns starch into sugar.

In considering Dr. Petersen's masterly exposition of an attitude towards disease and a method of treatment differing in many respects from these strictly specific conceptions, it ought to be said at the outset that it implies no contradiction of Sir Almroth Wright's views. Indeed, Sir Almroth Wright is almost the only English name quoted in a remarkably complete bibliography, in connection with the evolution of the modern non-specific method. This method is only of some six years' birth; it is widely known in Germany and America, somewhat less so in France and Italy, and very little considered as yet in this country. It is an amplification rather than a refutation of the specific theory of resistance to disease.

In the process of this new therapy, a large variety of substances are injected into the skin or blood-stream. A casual glance at a list of them might lead to a fear that the doctor had mistaken the kitchen cupboard for the medicine chest, for yeast, milk, eggs, cheese, and gelatin feature prominently. But there is a common basis for their injection; they all contain a complex chemical compound known as Protein. It has long been known that when protein is injected into the blood-stream, enzymes, to which we have alluded above, are produced which digest or destroy it. The injection of protein is always injurious in itself, since it sends up the temperature and causes many disagreeable symptoms. Bacteria themselves consist of protein; when they die they break up into poisonous substances, and in their life they excrete poisons derived from proteins, and the body in which they live produces similar poisons on account of their presence. One of the lines on which the body counteracts their evil influences is by the production of enzymes which destroy protein and the substances derived from it.

So when milk or egg is injected, it is argued that an immense number of enzymes are produced, capable not only of splitting up milk or egg, but also bacteria and their products. At the same time we get the temperature rise and the other symptoms, but these are a small price to pay for the destruction of the bacteria.

We might ask what advantage it is to inject the proteins of milk, when we might inject the protein of the bacterium itself. If it be proved that better results follow the milk injection, the question is of only theoretical interest. Moreover, the method is applicable, according to the author, in cases where the bacterium is unknown. But the answer to the question appears to be that, whereas on injecting the bacterium only these enzymes, which digest the bacterium and its products, are produced by the body, the milk injection is followed by the production, among others, of enzymes which digest the poisonous products of the body's own abnormal workings. But here we are admittedly on very uncertain ground, and further investigation is required.

Such is the method and its theoretical basis. There is no space here for a review of the results of experience which Dr. Petersen brings together in this book. Some criticisms at once occur to us—for example, on p. 156, a death-rate of 15 per cent. is noted in typhoid fever when treated on these lines, and in contemporary textbooks of medicine a mortality of from 5 to 20 per cent is quoted as normal with conventional treatment. In fairness it should be added that on p. 158, a series of 350 cases shows a mortality of only ½ per cent.; but as a Roland to his Oliver we can quote figures from one ward in a London hospital, where conventional treatment shows a mortality of 0 per cent. in 57 cases. Again, the most remarkable cures are reported in the case of chronic joint affections, which are notoriously the chosen sphere of every new therapeutic method from faith-healing to bone-setting—they appear to yield to a limitless variety of treatment for a time.

It should be mentioned, also, that the injection of protein is only one side of a scheme of treatment which aims throughout at producing a general reaction to a disease, and which covers a large field, including X-ray treatment and the old-fashioned mustard blister.

But, when every possible criticism has been brought forward and due allowance made for the enthusiasm of a prominent exponent of the method, this book remains a most valuable contribution to our knowledge of the problems of disease and immunity, and as a book of reference should prove invaluable to the specialist. And if the value of the method be established, medicine would be rid of much of that atmosphere of pessimism and mere academic classification which broods over it to-day.

R. J. V. P.

General Astronomy. By H. Spencer Jones, M.A., B.Sc. (Edward Arnold & Co., 21*s.*)

The Chief Assistant at the Royal Observatory, Greenwich, has succeeded in writing the best introduction to astronomy in English. There has been a need for such a book, for we have endured too long successive editions of the great textbooks of the past with their lack of freshness and, despite the labours of revising editors, their complement of error. Now comes this book giving a reader a tolerably complete view of the present state of astronomy, an account at once lucid and scientific from which the higher mathematics have been entirely excluded.

It should appeal to the amateur no less than to the student.

The author starts with a discussion of the celestial sphere, and then describes the earth, the moon, and the sun. Among the subjects considered may be mentioned the size and motions of these bodies, their distances from each other, the occurrence of eclipses and occultations, and the phenomena of sunspots. Then follow two chapters describing the latest astronomical instruments and methods of making observations. Next comes an account of planetary motion and a description of the planets and their moons. Subsequent chapters are entitled " Comets and Meteors," "The Stars," "Double and Variable Stars," and " The Stellar Universe." The plates which adorn the book contain a very representative set of astronomical photographs. The author has been in a position to choose them carefully, and he has seen to it that they have been accurately reproduced. A. S. R.

Synthetic Colouring Matters. Vat Colours. By J. F. THORPE, C.B.E., D.Sc., F.R.S., and C. K. INGOLD, D.Sc. (Longmans, Green & Co., 16*s.*)

Indigo, derivatives of indigo and of the substance anthraquinone are the most important members of the series of colouring matters known as vat-dyestuffs. These pigments are insoluble in water and many other solvents, but by a slight chemical change may be made soluble and then incorporated in the fibres of fabrics. On exposure to the air the original insoluble pigment is regenerated *in* the fibre, in which it becomes fixed exceedingly firmly. Dyes produced by this method—vat colours—are the fastest, most brilliant, and most valuable of all colouring matters. Professor Thorpe and his colleague, Dr. Ingold, have made a careful and documented compilation of the principal properties of, and processes relating to, these dyes, writing, as they are qualified to do, both from the " theoretical " and the " practical " point of view. It is a book invaluable to the organic chemist, and is a worthy member of Sir Edward Thorpe's *Monographs on Industrial Chemistry.* The publishers, too, are to be thanked for the general excellence and accuracy of the printing (the misprints we have noticed do not confuse), and for the low price at which a book for specialists of nearly five hundred pages is offered for sale.

Practical Chemistry. By LYMAN C. NEWELL, Ph.D. (G. G. Harrap & Co., Ltd., 6*s.*)

An American book which is not a " Practical Chemistry " as we understand the term, but a " first-year " theoretical chemistry of an elementary kind, with the usual facts clearly explained and the usual processes well illustrated. The custom of American textbooks of chemistry of having innumerable photographs of everything described is not departed from.

Introduction to the Plant Life of the Oxford District. I—General Review. By A. H. CHURCH, M.A., F.R.S. (Oxford University Press, 3*s.* 6*d.*)

The latest of Dr. Church's Botanical Memoirs (No. 13) is more popular in appeal than its predecessors. Its one hundred and thirty-five pages contain chapters on the physical features of the Oxford district, on its primary woodland, its subordinate and herbaceous flora, the presence of the hand of man, and on artificial plant-formations. Most of the book can be read and enjoyed by all who, even though lacking an intimate knowledge of botany, love the countryside which is described. There are fifteen large photographs of wood and copse and stream illustrating the flora of fast-disappearing districts in the neighbourhood of Oxford. The book is good all through, full of information of many kinds, and is worthy of a botanist who knows thoroughly the district described. It is of immediate interest to Oxonians and, as a record of existing things, should be valuable in fifty or a hundred years' time.

Common Science. By CARLETON W. WASHBURNE. (G. Bell & Sons, Ltd., 4*s.* 6*d.*)

A collection of about two thousand questions asked by children forms the foundation on which this book is built. Rather than decide what it is that children ought to know, or what knowledge could best be fitted into some educational theory, an attempt was made to find out what children wanted to know. The obvious way to discover this was to let them ask questions.

The questions collected were asked by several hundred children in the upper classes of an American elementary school over a period of a year and a half. The questions gave a very fair indication of the parts of science in which children are most interested. Physics in a simple form came first ; astronomy next ; chemistry, geology, and such parts of physical geography as deal with weather, volcanoes, and earthquakes came third ; biology with physiology and hygiene made a close fourth ; but nature study, in the ordinary school sense of the term, suggested very few questions. Not all, however, are answered in this book. Questions relating to descriptive astronomy and geology have been omitted, and those relating to biology have not been stressed. The book, indeed, deals principally with physical and chemical principles. Within its limits it is excellent. The information is accurate and so presented that school boys and girls may be entertained as well as informed. The book is well illustrated by photographs of boys and girls doing the large number of experiments described in the text. It should make a good present for any boy or girl who is developing an interest in physical science and who wants to know such things as why the Leaning Tower of Pisa doesn't fall over, how things stick to one another, why it is preferable to face forward when alighting from a moving 'bus, and what makes the ocean look green in some places and blue in others. The chapter on Electricity is specially clear and well illustrated. The author has his pupils repairing blown fuses, making arc-lamps, electro-plating, and sending messages with a cigar-box telegraph.

The book just buzzes with information on all the elementary scientific matters that crop up in the course of everyday life. There must be few whom it cannot interest. Teachers who require to give elementary scien-

tific talks and demonstrations of a popular kind should see it.

The Mathematical Theory of Relativity. By A. S. EDDINGTON, M.A., F.R.S. (Cambridge University Press, 20*s.*)

This is a systematic and comprehensive treatise on the mathematical theory of relativity, written for physicists possessing a strong mathematical equipment who have already obtained a general acquaintance with the theory in a less technical form such as from the author's previous book, *Space, Time and Gravitation.* It formulates mathematically the new conception of the world described in the other work, and follows out the consequences to the fullest extent. It should take its place as the standard mathematical work in English on relativity.

A. S. R.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Primitive Ordeal and Modern Law. By H. GOITEIN. (George Allen & Unwin, Ltd., 10*s.* 6*d.*)

The Religion of Science. By PROF. WILLIAM HAMILTON WOOD. (Macmillan & Co., Ltd., 6*s.*)

Supplying Britain's Meat. By GEORGE E. PUTNAM, B.Litt. (George G. Harrap & Co., Ltd.)

Great and Small Things. By SIR RAY LANKESTER, K.C.B., F.R.S. (Methuen & Co., Ltd., 7*s.* 6*d.*)

PHILOSOPHY AND PSYCHOLOGY

Psychological Types, or The Psychology of Individuation. By C. G. JUNG, M.D., etc. Translated, with an Introduction, by F. G. BAYNES, M.D. (Kegan Paul, 25*s.*)

Hypnotism and Suggestion. By LOUIS SATOW. Translated by BERNARD MIALL. (George Allen & Unwin, Ltd., 10*s.* 6*d.*)

Duality. A Study in the Psycho-analysis of Race. By R. N. BRADLEY. (George Routledge & Sons, Ltd., 6*s.* 6*d.*)

The Soul of the State, or (The Know Thyself). By PHIL. AL. PHIL. Vol. I. (Printed by Athanasios Papaspyrou, Athens.)

SCIENCE

Suggestions for the Prevention of the Decay of Building Stone. By J. E. MARSH, M.A., F.R.S. (Basil Blackwell, 1*s.* 6*d.*)

The Constitution of the Universe. By LOUIS STROMEYER, A.R.S.M. (Bangalore: Higginbothams, Ltd., Rs. 6.)

Wind and Weather. By ALEXANDER MCADIE. (Macmillan & Co., 5*s.*)

Crystallisation of Metals. By COL. N. T. BELAIEW, C.B. (University of London Press, 7*s.* 6*d.*)

Our Solar System and the Stellar Universe. By REV. CHARLES WHYTE, LL.D., F.R.A.S. (C. Griffin & Co., Ltd., 10*s.* 6*d.*)

Geology. "Science for All" Series. By C. I. GARDINER, M.A., F.G.S. (John Murray, 3*s.* 6*d.*)

The Elementary Principles of Lighting and Photometry. By JOHN W. T. WALSH, M.A., M.Sc., F.Inst.P. (Methuen & Co., Ltd., 10*s.* 6*d.*)

The Structure of Atoms. By DR. ALFRED STOCK. Translated by S. SUGDEN. (Methuen & Co., Ltd., 6*s.*)

Richter's Organic Chemistry. Vol. III—Heterocyclic Compounds. Translated by E. E. FOURNIER D'ALBE, D.Sc. (Kegan Paul, Trench, Trübner & Co., Ltd., 25*s.*)

Correspondence

RAINFALL AND CIVILISATION

To the Editor of DISCOVERY

SIR,

With respect to Colonel Haig's very interesting article on the above, might I suggest that the movement of the earth's axis, known as "Precession," might be the cause of the shift northwards of the desert belt which he so clearly points out? This movement of the earth's axis must, of course, involve a correspondingly slight shift in the tilt of the plane of the earth's equator to the ecliptic. It thus necessarily follows that there must be a slight shift, north and south of the earth's equator, of the sun's maximum heat. The desert belts must reciprocate this shift. There is, therefore, a true scientific basis for his statements. Theoretically the desert belts ought to shift north and south under the action of Precession. Colonel Haig has shown that they do so. According to Professor Young, "At present the pole star is about $1\frac{1}{4}°$ from the pole. At the time of the star catalogue of Hipparchus it was 12° distant from it, and during the next two centuries it will approach to within about 33′, *after which it will recede.*" Therefore in two centuries from now the northern limit in the shift of the desert belts will be reached and the southern shift begin. Spain, Persia, etc., may therefore expect their rainfall to decrease very slightly during the next two centuries. After this their rainfall will increase, and it will be 25,867 years (the period of Precession) before a similar state of things returns. The Mediterranean basin, etc., have, therefore, not much more to fear on account of increased scarcity of rain. They will become fertile again as the desert belt shifts southwards in response to the Precessional movement.

Another piece of evidence of shift in this belt is that of ancient Canaan. See (*inter alia*) Num. xiii. 23, 27, and Deut. viii. 7, 8. The dates here involved fall in remarkably well with the Precessional period. From three to four thousand years ago the Near East and the Mediterranean basin could and should have had much more rain than today. In another four or five thousand years they will again be fertile and remain so for about fifteen thousand years; after which the drought will again be setting in.

Yours, etc.,

H. J. ALLEN.

TREALES VICARAGE,
KIRKHAM,
LANCS.
December 29, 1922.

To the Editor of DISCOVERY

SIR,

This highly interesting article, which has inspired a column in *The Times*, touches on a subject of such evident importance to the human race that one hopes it will not be allowed to drop without discussion.

Having read Colonel Haig's contribution with some care, it hardly seems possible that the "Cosmic" factors, adduced by him at the end, can have been satisfying to his own mind. Perhaps he has intended to be provocative. May it be permitted to comment briefly on the causes adduced to account for the (implied) drying up of the world's water?

(1) Water is locked up by glaciation, but we are supposed to be living in a period of deglaciation which has lasted some thousands of years.

(2) Vegetation has no doubt locked up a certain large amount of "capital" water, but its aqueous incomings and outgoings must strike a fairly accurate balance and its influence be more beneficent than otherwise, in that it assists the circulation of water.

Regarding other chemical action, it is difficult to see how much water can enter into fresh combinations except as a result of the assumed cooling of the earth.

(3) Water is a very stable compound by no means readily broken up into its constituent gases, and even so practically only by human contrivance.

(4) It is hard to believe that the cooling of the earth can have made itself apparent in the course of some 6,000 years. It has been suggested that the earth is not cooling, but is even getting hotter owing to the influence of its radio-active constituents.

Colonel Haig brings out one significant fact very clearly, namely that the deserts of the Northern Hemisphere have all been centres of civilisation and that their degradation from fertility to desert conditions has been extraordinarily rapid. Do we know any influence but man's on the earth that produces such results in so comparatively short a time? Another important fact brought out is that deserts, once established, tend to spread.

Yours, etc.,

FRANK W. HERBERT.

18 UPPER PHILLIMORE PLACE,
KENSINGTON, W.8.
January 3, 1923.

TESTS OF MUSICAL ABILITY

To the Editor of DISCOVERY

SIR,

May I suggest one factor in musical ability which hardly seems to me to be treated as sufficiently fundamental in Mr. Thouless's extremely interesting article, in your March number, on "New Methods of Judging Musical Ability"? I refer to the power to retain in the mind auditory images, accurate in pitch, of a note heard. The power to sing in tune clearly depends rather on this than on ability to distinguish fine intervals. I believe there are persons whose ear is sensitive to fine variations of pitch, but who find it hard to compare two notes because no really sharp auditory image of either can be called up; just as I have met persons who could match delicate shades of colour perfectly so long as both colours were before them on the table, but who were uncertain in naming colours, because they had no clear mental gallery of colours for purposes of identification.

Another factor in musical ability that occurs to me is the degree of complexity of sound of which a person can form an image. Some musicians are said to be able to hear mentally the playing of a whole orchestra. Many persons, probably, cannot hear distinctly a three-note chord. Very often, in these cases, what remains in their minds after the chord has died away is not really sound at all, but something vaguer: a sort of "emotional atmosphere." The precise nature of this "atmosphere" might be worth investigation, and also, perhaps, the kindred question of whether music in a minor key invariably tends to suggest sadder emotions than music in the major.

Possibly most of these points are really included under one head or another of Professor Seashore's method, but from Mr. Thouless's necessarily summarised account it is difficult to be sure.

Yours, etc.,

C. B. DAVY.

27 GROVE TERRACE,
CLAY PIT LANE,
LEEDS.
February 28, 1923.

WE regret that an error occurred (on page 72, col. 2, last sentence) in the publication of Mr. R. H. Thouless's article on the subject, which appeared in our March number. The reader will get the right meaning by substituting the word "pitch" for "time" in both cases where the latter word has been inserted in this sentence.

Miscellanea

RECENT DISCOVERIES OF ANCIENT HUMAN REMAINS

Two interesting discoveries of ancient human remains were announced towards the end of the month of February. The *Daily Mail* of February 26th published a sensationally written report of the discovery of a well-preserved dolmen, or chamber of large upright stones with a flat stone cap, at St. Ouen, Jersey, in the course of excavations by workmen at the back of a house. With the dolmen was associated a kitchen midden, or refuse heap, full of limpet shells, a stone for grinding corn, and an ancient human skull. The skull was very much flattened, so much so that it was said to have no forehead at all, and on this account it was suggested that it belonged to a type very much older than that of *Pithecanthropus erectus*, the ape-man of Java, while the kitchen midden was thought to belong to the Mesolithic or Pre-Neolithic Age, presumably on account of its resemblance to the kitchen middens of the Baltic area which belong to this period. The discovery is interesting, but neither of these sensational suppositions is well founded. The flattened appearance of the skull, in all probability, is merely due to post-mortem flattening by pressure after burial, a thing which often happens in the case of prehistoric skulls, while the shell heaps are not necessarily very early in an island in which the limpet has always formed an important article of diet. The association with a dolmen suggests a Late Neolithic date.

A more interesting discovery is announced from Pata-

gonia. According to a Reuter's telegram from Buenos Aires, published in *The Times* of February 28th, Dr. Wolf, in the course of a two years' expedition to Patagonia on behalf of the La Plata Museum, has discovered a fossilised human skull of Tertiary Age. If investigation of the details of discovery and of the geological conditions in which it was found confirm the view that it belongs to the third great geological epoch into which pre-recent geological time is divided, and if an examination of the form of the skull shows that it is really of primitive type, it would mean that the oldest known human remains have been discovered in South America antedating by many thousands of years *Pithecanthropus erectus*, the earliest ancestor of man at present known, and the fossil tooth said to be human or sub-human in type and of Pliocene Age recently found in Nebraska. It is hardly necessary, however, to remind our readers that evidence for the existence of man in Tertiary times in South America, which has been brought forward up to the present, has not hitherto withstood criticism, as was shown recently in these columns.

THE PRESERVATION OF ANTIQUITIES

The public interest in antiquities, especially Egyptian, has recently been stirred by the discovery of King Tutankhamon's tomb. The accounts given in the daily Press of the operations at Luxor have stimulated curiosity and interest in a way that is reflected by the attendance at the British Museum; the collection of Egyptian and Assyrian antiquities in the Museum is now constantly thronged with visitors.

Many visitors will have noticed here and elsewhere in the Museum that a number of the specimens show unmistakable signs of decay; metals appear encrusted and corroded; wood, rotten and fragile; earthenware, cracked and broken. This all seems quite natural, but when he is drawn—as he inevitably is—to the Egyptian mummies, the visitor sees an arrestment of decay that is startling. Surely, if the human body can be preserved through thousands of years, means can be devised for preventing the deterioration of stone, metals, wood, etc. The corroded and decayed appearance of many museum objects arises from the fact that they were received in this state and that little or no attempt has been made to clean and restore them. Failure to do so is due partly to æsthetic and antiquarian reasons, and partly to lack of knowledge of suitable restorative processes, and partly to fear that irreparable damage to the precious objects may occur.

The embalmers of Egypt did not attain their object solely by the use of chemicals; before treatment the body was thoroughly and carefully cleaned. It is interesting to note that this is precisely the line of attack that is being adopted at the British Museum. For some time practical scientific investigations have been conducted in the Museum under the direction of Dr. Alexander Scott, F.R.S., with the object of discovering the causes that have led to the deterioration of specimens and of devising suitable methods for arresting the decay. In the majority of cases it has been found that mineral salts are responsible for the damage; these must be removed if permanent restoration is to be obtained. In other words, the specimen must first be thoroughly cleaned and then treated with preservative reagents.

Work of this nature obviously involves difficult and delicate operations. The use of an unsuitable method or chemical may destroy the specimen, spoil its appearance, or otherwise diminish its antiquarian value; both the knowledge of the chemist and the solicitude of the antiquarian are needed. A single example of the successes achieved will serve to show how true this is.

Some carved wooden figures, that had been lying for probably two thousand years under guano deposits, were brought to the laboratory in a very dilapidated condition; the wood was soft and spongy, and could scarcely be touched without causing damage. By analysis of a fragment the presence of harmful mineral salts, partly derived from the guano, was detected. But here a difficulty arose; when immersed in water, nearly half of the material of the fragment was removed; water, consequently, could not be used to wash out the salts from the images. Consideration of the nature of the material removed by water suggested, and experiment confirmed, that dilute acids could safely be used to remove the destructive salts and these alone. After this treatment the figures were still soft and spongy; some means of strengthening them had to be found, and in solving the problem the faculties of the chemist and antiquarian were employed to ensure that no harmful constituent was introduced and that their appearance was unchanged. The problem was solved; the deterioration of the wooden figures was arrested, and they can now be handled without danger.

These and other problems are discussed in a Report[1] that has just been published. It is impossible here to do more than indicate some of the results which are described in the pamphlet. Exhibits of metal, such as spear-heads and coins, that were brought to the laboratory corroded and apparently of no use for museum purposes, were restored to their original appearance. Earthenware, previously crumbling at an alarming rate, has been rendered quite sound. Paintings in which the high lights had blackened have been restored and, moreover, the treatment is such that there should be no recurrence of darkening. Varied and numerous objects of silver, lead, copper, and bronze which had been seriously corroded have all been successfully restored.

The appearance of this Report at the present time is most opportune, since the methods described can hardly fail to be applicable to some of the antiquarian treasures now being removed from the tomb at Luxor.

The Report should be of interest to many besides museum curators and art dealers; antiquarian, scientist, and private collector alike will find much that is helpful and suggestive in its pages. The text is illustrated by many excellent collotypes arranged to show in a clear way the value of the restorative processes which are described.

[1] *The Cleaning and Restoration of Museum Exhibits.* Second Report upon Investigations conducted at the British Museum. Published by H.M. Stationery Office, price 2s. net. Copies are obtainable directly from H.M. Stationery Office, at the following addresses:—London: Imperial House, Kingsway, W.C.2; 28 Abingdon Street, S.W.1; Manchester: 37 Peter Street; Cardiff: 1 St. Andrew's Crescent; Edinburgh: 23 Forth Street or through any bookseller. The post-free price is 2s. 1½d.

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Editorial Notes

THE wise man looks on food as one of the reasonable pleasures of existence; the learned man as an ever elusive mystery of chemical changes; the diet-reformer as a kind of obstacle race, where obscure vetoes forbid a straightforward and hopeful progress from soup to savoury. In these days, when the produce of the uttermost earth comes to our tables in tins and bottles, when nearly every food has undergone a course of more or less drastic "treatment" before it is deemed suitable, the wise man might well take a leaf from the book of his learned and his apprehensive fellows, and consider more deeply the merits of his diet. "Hare, a black meat," said old Robert Burton.[1] "Melancholy and hard of digestion, it breeds *incubus*, often eaten, and causeth fearful dreams." But how would he have looked on rabbit which came frozen from the Antipodes! "That which Pythagoras said to his scholars of old may be for ever applied to all melancholy men—*A fabis abstinite*—eat no peas or beans." Pork is "too moist, full of humours"—and with what terrible denunciations might he have visited them, had he met them united in a tin? True, Robert Burton must have been a delicate eater, for only carp—and that not with certainty, for is it not a "slimy nutriment"?—and dill, balm, and succory appealed to his learned and critical palate as righteous food. But, if we substitute the danger of chemical contamination for his incubus, the danger of the destruction of vitamins for his melancholy, and the numberless physical disablements which follow improper feeding for the humours which menaced him, we may well feel inclined to view our modern kitchen cupboard with his stern disapproval.

[1] *Anatomy of Melancholy.*

* * * * *

The full-blooded, thorough-going vegetarian is a fairly rare individual, and the question of the best relative proportions in our diet will probably always be solved for the majority by personal taste, and quite satisfactorily solved. But the problems of adequate feeding are more subtle than the mere question of how much fat and lean Jack Spratt and his wife may care to eat. Professor Hopkins, of Cambridge University, in his epoch-making experiments on the feeding of rats, proved that the presence of many substances, minute in their quantity, was vital for successful nurture. There is no certainty yet as to whether preserved foods contain some of these substances at all, although the wholesale experiments which the Army underwent in the late war proved that "bully beef" undoubtedly has a value, and even a charm of its own, if eaten with reasonable discretion. Bacterial contamination is so rare that the disaster in Scotland last year stood out as a notable exception. Chemical strangers in food are perhaps a greater danger; the cumulative effect of small doses of a poisonous substance may be by no means negligible. We are as a community dependent on the unceasing activities of Government authorities for our safety in ensuring the purity of our food; but the determination of the essential factors in diet remains the function of the biological investigator, and is in fact among the most important duties which he is called upon to fulfil to-day.

* * * * *

The confidence with which we habitually use phrases, whose origin and exact meaning eludes even the curiously-minded who inquire into the mystery, is a very wonderful thing. There was, not long ago, a correspondence in the *Observer* as to what exactly

"getting the wind up" means, and how it came to mean it. Aeronautics, big-game hunting, and even irascibility were invoked as inspiring the metaphor, and had their several partisans. There is another phrase—also popular during the war—whose origin is equally mysterious, though its meaning is quite clear—and that is "Money for jam." We imply—if we are undignified enough to employ the phrase—that we are gaining an advantage at the expenditure of quite disproportionate effort. We hazard the suggestion—without much confidence—that the phrase had its origin in a suspicion that Army jam rations were composed of materials which rendered any change—however small—a source of exceeding profit. Be that as it may, "Money for jam" is a most alluring prospect for mankind. It drives men to make furniture of soap-boxes, to buy useless but ponderous tomes at second-hand bookstalls, for the sole reason that they are in the fourpenny box; it is the root instinct that has inspired and nurtured the noble profession of bookmaking. There is a fascination in making the apparently valueless a source of profit and wealth—in making the desert blossom like a rose.

* * * * *

And the desert is quite ready to blossom, if rightly and intelligently handled. There was published during the war, when the question of home-grown foods became pressing, a little work which endeavoured to enumerate, in a lamentably small space, all native articles of diet. They included the thighs of grasshoppers and the young of the rat; the eggs of the sparrow and the leaves of the dandelion; the caterpillars of the white butterfly and hedgehogs. Not, perhaps, a feast worthy of Lucullus, but at least a novel menu—something beyond the Delicatessen shops—might be produced by the undaunted epicure at the expense of an afternoon in the meadows, and perhaps a few hours in the rat-nurseries by the London docks. But when all is said, and the last grasshopper's thighs deliciously eaten, it must be admitted that our native land is not a Swiss Family Robinson island; it has its limitations. While hunting on Epsom Downs for the larvæ of a rare moth, an entomologist was stopped by a gipsy. "What are you looking for?" asked the gipsy. "Grubs," said the entomologist, coming down to his level. "Grub!" said the gipsy. "You won't get much grub that way." And gipsies, says George Borrow—and doubtless he is right—are a knowledgable crowd. That is not the road to "Money for jam."

* * * * *

But there is another. Wide stretches of these islands are barren—beautiful, but barren. The bog-country of the centre and west of Ireland is a source of peat, it is true, but of little else. There are 400 square miles of sandy soil in Suffolk and Norfolk alone which are useless, as they stand, to the agriculturist, and grow only heather and bracken. There are sand-dunes by many a sea-coast; wide stretches of mud or shingle; salt-marshes where only sea birds can take delight, and land covered with refuse from pit-heads where nothing can. Are we to leave these waste lands uncultivated for all time? Can nothing be done to make them yield pasture, timber, or crops? This question is occupying the attention of a great many workers. For example, sandy wastes have been made productive by growing lupins on them and so rendering them more capable of holding water, and allowing the crop to be dug into the soil as a manure. Holland, of course, has long known how to win wealth from a poor and barren land; the bulb gardens of the Low Countries are famous the world over. The drainage of the fen-country of Cambridgeshire is one notable success for English methods, even though much yet remains possible in those wide and lonely stretches. Pit-head refuse will often permit of the growth of trees useful locally for pit-props; shingle beaches, Professor F. W. Oliver believes, might be made productive by growing "nurse-plants" there, which would enrich the soil and enable other plants to be grown later. Research on these questions is being actively pursued both at Cambridge and Rothamsted, and the Agricultural Department at Leeds University is supervising work in Yorkshire on the improvement of poor pasture-land. A most interesting discussion of these subjects is given in a little volume entitled *The Exploitation of Plants*,[1] which offers several suggestions for the utilisation of national resources yet neglected.

* * * * *

Animals and their intelligence, insects and their brains, man and his mere automatism—these are subjects which recur perenially as year by year another generation awakes to their importance and difficulties. It is notable that those who believe most emphatically that there are mental processes in animals comparable to those in man, are the men who, like the late W. H. Hudson and the "inimitable observer" J. H. Fabre, the insect's Homer, have spent long days in silent and sympathetic observation of the doings of dumb creatures in their natural surroundings. Those who look upon them as complicated machines have oftenest examined them with complicated machinery. We cannot decide between them; we can but observe the extreme views. The primitive one-celled organism in a drop of ditch water appears to absorb suitable food and to discard the indigestible residues, and

[1] J. M. Dent & Sons, 2*s*. 6*d*.

neglects the unsuitable completely. Is this a sentient choice? Professor W. M. Bayliss (*Principles of General Physiology*) writes as follows: "If a fine piece of glass rod be pushed against a drop of chloroform under water, it cannot be made to enter the drop; on releasing the pressure it is immediately rejected. If, on the contrary, the rod be first coated with shellac, it is at once sucked in. As soon as the shellac is dissolved by the chloroform, the rod is thrown out again." The analogy is certainly striking. Take the other extreme view, as presented by W. H. Husdon in *A Hind in Richmond Park*: "A life-long intimacy with animals has got me out of the common notion that they are automata with a slight infusion of intelligence in their composition. The mind in beast and bird, as in man, is the main thing. Man has progressed mentally so far that, looking back at the other creatures, they appear practically mindless to him. . . . One might compare the animal in that state in which I watched her, resting after feeding, chewing the cud, and at the same time agreeably occupied in listening to the little woodland sounds, to the man who, after dining well, smokes his cigar in his easy-chair, and amuses his mind at the same time with a book—a fascinating story, let us say, of old unhappy things and battles long ago."

* * * * *

The death of Sir James Dewar has removed from the world of science one of those rare giants of intellect and achievement of whom each age produces but a very few. Although all of us have employed a development of his discovery, the "vacuum flask," to meet our picnic needs, few realise what marvellous feats of engineering skill and scientific resource were associated with that domestic device in his hands. The liquefaction of gases which had resisted the efforts of others, and innumerable experiments on their physical properties in that state, was only a small part of his full measure of success in research; his "vacuum flask" was devised to prevent these strange liquids boiling. His life-work marked a step in the ladder of the progress of the world's knowledge, and to few has it been granted to leave so permanent a mark on the history of their time and of all time.

* * * * *

The suggestion that a charge should be made to the general public, though not to students, for the privilege of entering the British Museum has, we are glad to note, not been put into effect. It is our boast that the most priceless possessions of the nation are enjoyed without cost; and the discrimination between student and dilettante savours of snobbery. Our sympathies are all with the dilettante, for few can enter that great monument to learning to whom all the contents are an open book, and none to whom some spot has not the charm of intimacy and personal appeal. It is against all the traditions of the British Museum that it should compete with the cinema as a source of income and profit. The excellent publications which it produces for the information of visitors to its various rooms are supplied at a cost which is certainly disproportionate to their value and the expense of production. Many will have found, for example, that the guide to the Egyptian collection, modest though its price is, was invaluable as a source of knowledge and perspective concerning the times and activities of the old kings of Egypt, during their recent resurrection to world-wide attention. We are glad that the almost universal protest against any action which might serve to limit the freest access possible to the treasures of the past has had its effect. The British Museum consists in great part of exhibits, priceless in themselves, yet presented without recompense, and surely it was the intention of such donors that their public-spiritedness might be enjoyed without charge.

* * * * *

What is the psychology of the modern psychological novel? If the stage-coach driver and the innkeeper were material adequate for Dickens, why have we not our masterpieces with taxi-cab drivers and public-house landlords for heroes? It may be that the novel, like the poem, must always have something of the archaic about it to strike a note of literary charm; even though we have not a novel of the Scotch express, perhaps we may soon have one with Stephenson's first creation as motif. The world, like port and cheese, must mature before it is material for the epicure. Meanwhile, the novelist has flown to analysis; instead of portraying character with the infinitely subtle skill of a Jane Austen, and exposing a soul by the flicker of a handkerchief, he grinds out a monstrous picture of a mind distracted by multitudinous conflicting but neatly labelled motives and instincts. But how inferior an art it is, how unfair an evasion of the novelist's first duty! It is for him to select from the mass of human action and speech those flashes which illuminate the whole of a life for us. The psychology is for our inward comment; we may not care to know why Iago hated Othello; we shudderingly realise that he emphatically did. The psychological novelist is like the child who draws a nameless and unthinkable creature on a slate and writes as legend "This is a Kow." But even the child realises that he has somehow cheated; there should have been an irradiating bovinity somewhere. The novelist is cheating too; psychology may be a romance in the hands, say, of William James; romance can never be psychology.

Eclipses of Jupiter's Satellites and Their Use for Determining the Velocity of Light

By Sir Oliver Lodge

THERE is some misunderstanding as to the way in which the eclipses of Jupiter's satellites enable the velocity of light to be determined. It is often thought that there is a delay in these eclipses when the earth is a long way from Jupiter, as compared with the times of their recurrence when the earth is comparatively near. The distance between the two positions is the whole diameter of the earth's orbit, that is to say, 186,000,000 miles, and undoubtedly light takes about sixteen minutes to traverse that distance. But the observation is not made in that way, nor is it feasible to make it in that way.

The satellites revolve round Jupiter like the hands of a clock, and what can be observed is the gaining or the losing of that clock. This gain or loss is at a maximum when the earth is moving full speed to or from Jupiter, that is to say, when it is at a mean distance. There is no gain or loss observable when the earth is either at a maximum or minimum distance. The clock would then be observed to keep right time, or, in other words, the satellites would complete their revolution, and be eclipsed, in their true period. Distance would make no difference. Speed only is effective. The apparent variations in the time of revolution would be experienced when the earth was moving either away from Jupiter or towards it. If it is moving away, the time of revolution would appear longer than usual. If it is moving towards, the time of revolution would appear shortened.

The Analogy of Sound

It is in fact a case of what is called the "Doppler Effect," which is most easily observed in the case of sound. The rate of vibration of a sounding body can be estimated by the pitch of the note it emits. If we are moving towards the source—or what is the same thing, if the source of sound is moving towards us—the rate of vibration appears quicker than usual: which is the same as saying that the sound is raised in pitch, or appears shriller. If, on the other hand, there is a mutual recession between source and observer—as when we are on a train travelling away from a railway whistle—the pitch of the note is flattened; that is, the rate of vibration seems to us slower than it really is.

It is easy to observe this in the case of sound, because the velocity of sound is but moderate. It travels with about the speed of a revolver bullet, at the rate of a mile in five seconds. So that if we were on a carriage travelling away from the sound *at this pace* we should not hear the sound at all, for it would never overtake us. That rate of travel is impracticable by any artificial means of locomotion. But we can easily travel a mile a minute, which is one-twelfth of that rate, and accordingly a note would be lowered by about one-twelfth of its rate of vibration. So that if it were sounding the C in the treble clef, making 512 complete vibrations a second, it would sound to us, if we were travelling away from it at sixty miles an hour, as if it were making, not 512, but 470 vibrations a second, or something like that—a drop of nearly a whole tone.

It is not easy to observe the same thing in the case of light, because the velocity of light is so enormous: nevertheless it occurs. And if by a spectroscope we were able to determine the position of a line in the spectrum with sufficient accuracy—that is to say, if we were able to determine precisely the rate of ethereal vibration which was responsible for the light—we should observe a slight shift in one direction when we were moving away from it, and a corresponding shift in the other direction when we were moving towards it.

The only carriage which is sufficiently quick to cope with the velocity of light is the earth in its orbit, which is vastly quicker than even a bullet, since it travels nineteen miles in every second. And though even this is almost insignificant in comparison with the velocity of light, it is not quite insignificant. It is the ten-thousandth part of the velocity of light; and instruments of precision will show the effect, which is very well known and constantly allowed for. Some stars approach us much more rapidly than that, and the speed of their motion is determined by this very means. Sir William Huggins was the first to do it, and at the time of his observation he found that the star Sirius was receding from us at a considerable pace, I think as much as forty miles a second, which is proved by the displacement of its sodium line, so that the sodium in Sirius appeared to be vibrating more slowly, and emitting light of slightly more orange tinge, than sodium on the earth or any other body fixed with reference to the observer.

Sirius and its Companion

It is true that this recession of Sirius did not continue for many years. In the course of time recession was turned into approach, proving that the star was revolving round an unseen companion—a companion whose existence was therefore predicted or detected on this evidence alone, and was afterwards seen by means of the large telescope and keen eye of Alvan

Clark, in the clear air of America ; though its light is exceedingly dim owing to its low temperature. Its existence was detected, however, in the first instance, not by its luminosity, but by its gravitational influence on its bright companion.

And many another double star has thus been detected, some of them with components of equal brightness ; and as they revolve one is receding and the other approaching, which has the effect of causing every single line in their spectrum to appear double—half its light being shifted to the right and half to the left—although the stars themselves may be so close as never to be seen double by even the highest power telescope. Such is the remarkable phenomenon connected with the star β Aurigæ, which was discovered by one of the assistants working under the Draper Memorial for Professor Pickering, at Harvard, when examining photographs of the spectrum of a number of stars taken on successive days. The rate of revolution in this case is so enormous that a complete period was gone through in four days.

To return, however, to the eclipse of Jupiter's satellites, it is really a phenomenon of essentially the same kind as is noticed in sound or light, though it is observed by altogether different means. For here the period of revolution or vibration, instead of being a minute fraction of a second, is something comparable to a week or a month. And the completion of a period is observed by the periodical plunging of the satellite into the shadow of the planet, that is to say, by an eclipse. Making all proper allowances for shifting of our own position—which to an astronomer is simple enough—the period of revolution can be pretty accurately determined. The true value is obtained when the earth is nearest Jupiter and moving, as it were, sideways, not to or from that planet : and the true period is also observable when the earth is farthest from Jupiter, and again moving sideways. But at the halfway points, three months distant from either of these, when the earth is moving towards Jupiter, the period of the satellite appears accelerated, seeming to revolve in a shorter time than it really does, because the earth is constantly catching up the light which, by its appearance or disappearance, brings the message. On the other hand, when the earth is running away from Jupiter, the light from a reappearing satellite has to overtake an observer ; and accordingly we get the information late : so that, if we were not acquainted with the cause, we should assume that the satellite was revolving more slowly than its average value.

It ought to be said that when Roemer published his great discovery, as above summarised, it was regarded as fanciful and not accepted, because up to that time it had been thought that light travelled instantaneously, or perhaps did not travel at all. It simply existed. The fact that light really did travel at a definite speed was of fundamental importance. It was the first definite thing ascertained about the Ether of space, and was not to be lightly accepted. Like many another discovery, it had to run the gauntlet of controversy. And it was not till fifty years later, when Bradley, the Astronomer of Oxford, conceived the explanation of a quite different and still more delicate phenomenon which he had observed, viz. the slight shifting in the position of stars, so that they described some kind of ellipses or circles in the course of the earth's year—an observation which he ultimately explained as due to the finite velocity of light ; it was not, I say, until Bradley arrived at a

JUPITER, FEBRUARY 17, 1906.
From a drawing by the Rev. James Baikie, Edinburgh.

similar result, viz. that the speed of light was ten thousand times that of the earth in its orbit, that Roemer's theory was accepted and incorporated into science. For it was perceived that the two observations mutually sustained each other, although up to that time no terrestrial observation had been sufficiently delicate to enable the speed of light to be directly measured by experimenting with artificial sources on the earth's surface. This was done, as everyone now knows, by the great French physicist Fizeau, in 1849, and afterwards confirmed beyond the shadow of a doubt by Foucault ; so that the speed with which the Ether is able to transmit waves became the familiar and commonplace fact which it is to-day.

A Popular Misconception

I began this article by saying that there was much misunderstanding about the behaviour of Jupiter's

satellites in this connection, a misunderstanding which is often repeated even in textbooks, though I clearly indicated the accurate way of regarding the matter in my address to Section A of the British Association at Cardiff in 1891, and although Professor Tait in his treatise on Light had expounded it before. To illustrate the popular misconception it will suffice to quote from a quite recent article by Canon Edmund McClure, in *The Beacon*, called "The Ether and the New Physics," in which he speaks as follows about eclipses of Jupiter's satellites :

"The Danish astronomer Roemer found in 1675 that these eclipses were observed some 22 minutes earlier when the earth was at one point of its orbit than six months later, when it was farther away by the orbit's diameter, that is by 186,000,000 miles. Hence the light reflected from the satellite at the instant before its eclipse took 22 minutes to traverse the diameter of the earth's orbit. More accurate observations reduced the 22 minutes to 16, and it was an easy calculation to deduce from this that light was not instantaneous, as had been supposed, but travelled at the rate of 186,000 miles a second, a velocity confirmed by later experiments."

What Canon McClure no doubt means is that the accumulated discrepancies during recession or approach amounted in the end to the 16 minutes he speaks of. And that is one way of expressing the result : but it is not a clear and instructive way. It very often happens that the accurate method of regarding a phenomenon is really better and clearer, and always more instructive, than something modified to suit what is thought to be ordinary apprehension : and hence it seemed worth while to call attention to an improved mode of statement, which is more in accordance with the actual facts.

Recent Work on the Ridge Patterns of the Skin

C. A. Mitchell, M.A., F.I.C.

The general principles upon which identification by means of finger-prints is based are now so well known that most people are acquainted with the methods of classifying the patterns and of using them in the detection of crime. There are, however, certain new developments of the methods which are, as yet, but little known, and many interesting results have also been obtained which corroborate and amplify the experience of the pioneer workers on the subject.

Evidence is still being accumulated to show that the patterns are permanent throughout life. The late Sir William Herschel had a thumb-print made in 1859, and one made in 1914 was found to be identical with it. It will be long before his record of fifty-five years is beaten. A striking illustration of the indestructibility of the patterns, to which Dr. Faulds was the first to call attention, has recently been given by Mr. B. Wentworth, of New Dover, U.S.A., who has sent me a series of prints showing the effect of a burn upon the pattern and the gradual reproduction of the original design with the healing of the injury.

During the last few years I have made an extended series of experiments to ascertain after what intervals of time it would be possible to develop a latent imprint of a finger upon paper, such as the leaf of a book. For this purpose I have studied the various methods which have been suggested for the purpose and have devised several new ones (see *Analyst*, 1920, **45**, 122).

Up to that time these methods had been mainly mechanical in their action ; and my results indicated that their efficiency would largely depend upon the absorptive capacity of the surface of the material upon which the print had been made. For example, if a print has been left upon glass or upon the surface of a japanned tin box, it can be developed even after some years by dusting it with a suitable powder, such as a mixture of chalk and mercury or powdered graphite (as in the official English method), with lycopodium powder coloured with an aniline dye, or with heated red lead or lead iodide. Prints on highly sized paper can be developed in this way after some weeks, but those on ordinary paper will only give a poor result after a week or two, and imprints on blotting-paper, although they can be sharply developed for some hours after being made, will only show a faint smudge after about a week.

Methods of Developing Latent Imprints

The use of a liquid reagent was first developed by Forgeot in 1891, and after various experiments he found ordinary writing ink to be the most suitable for the purpose. The principle upon which its use is based is that there is normally a slight secretion of oil in the fingers, and that this is conveyed to the parts of the paper with which the ridges come in contact. The marking made by the ridges will therefore repel the ink, whereas the intermediate furrows and the rest of the paper will be stained. Prints made in this way are therefore "negatives," whereas those made by the mechanical method of adhering powder are "positive," the ridge receiving most of the pigment and the furrows remaining relatively uncoloured.

Various discrepancies have been recorded by subsequent workers who have used this method, but I have shown (*Analyst*, loc. cit.) that these are to be attributed to the fact that "ink" is not a standard reagent, but varies in its composition within wide limits. A reagent made by dissolving pyrogallol in osmium tetroxide (the osmic acid of the microscopists) gives an ink which darkens immediately on paper and gives very sharp results in the development of finger-prints, whereas an ordinary fountain-pen ink only darkens gradually on oxidation by the air.

Good results can be obtained with either ordinary ink or the pyrogallic ink reagent after a long time, and I have developed latent prints on paper after a period of more than three years.

The use of a gaseous reagent has many advantages over liquid or solid reagents. Iodine vapour gives good results, and I have developed prints with it after several years. The reagent has the drawback, however, of giving fugitive prints which are not easy to photograph. But osmium tetroxide vapour, produced by heating a little osmic acid solution in a basin, gives very good permanent "positive" prints, in which the ridges are grey, the furrows and the pore openings on the ridge dark grey to black. The method is less sensitive than development with iodine, and does not develop a print after the lapse of some months In the case of recent prints, however, it is very effective,

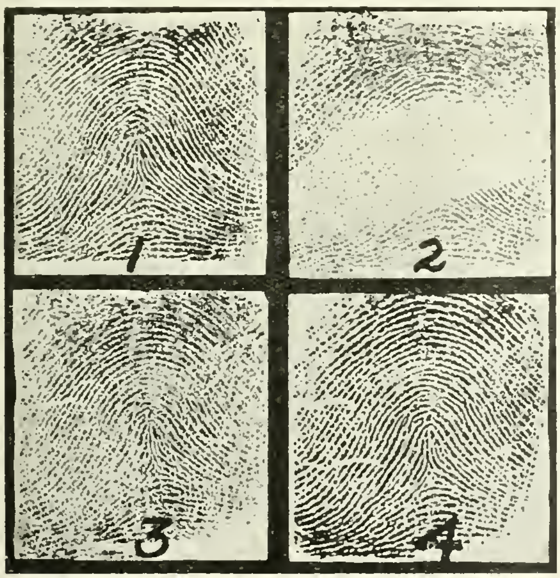


FIG. 1.—EFFECT OF A BURN UPON THE SKIN PATTERN OF A FINGER.

(1) Original print. (2) Immediately after burn. (3) After partial recovery. (4) After complete recovery.

(*By permission of Mr. B. Wentworth.*)

and is especially useful when a good record of the pores in the furrows is required.

A good outline has already been given in DISCOVERY (vol. ii, p. 257) of Dr. Locard's method of identification by poroscopy, which is an extension of the finger-print

FIG. 2. FIG. 3.

FIG. 2.—FINGER-PRINT DEVELOPED AFTER THREE YEARS WITH "SWAN" INK.

FIG. 3.—FINGER-PRINT DEVELOPED AFTER THREE YEARS WITH OSMIUM PYROGALLATE.

system to the enumeration and classification of the pores on the ridges.

The only point in this description which requires some correction is the statement (p. 259) that "Stockis . . . proved experimentally that the wearing of leather or indiarubber gloves need not prevent the formation of finger-prints, and in February 1912, in the S—— case, Dr. Locard put theory into practice by identifying a gloved burglar without any other proof than his finger-prints."

Now, what Stockis meant was that even gloves are not an absolute safeguard against the leaving of recognisable imprints unless all portions of the friction skin are completely protected. In Dr. Locard's case, (which I have recently read again in the original French) the hand was only "gloved" in the sense that it had been covered with a loosely woven "honeycomb" towel—a very different thing from its being in a fabric of leather or indiarubber.

Distinctive Footprints

Until comparatively recently the study of the patterns formed by the friction ridges on the soles of the feet has been almost completely neglected, and it has been left to Messrs. Wilder and Wentworth to devise an efficient method of classifying the somewhat complex patterns and to demonstrate their value as a means of identification. Their first attempts to make use of imprints from the toes were abandoned owing to the fact that these areas are frequently outside the contact area of a tread impression, and that even then the patterns are monotonous and unsatisfactory for

*

classification. They have therefore adopted a system in which classification is based upon the patterns in the "ball" area at the base of the great toe, and in the three areas (1, 2, and 3) termed the *plantar* area (*planta* = sole) lying beneath the other digits, together with the presence or absence of lower deltas (*d*).

They have found that the *ball pattern* is almost always present, whilst the three *plantar patterns* are of more uncertain occurrence, and may occur in any combination, forming whorls or loops. In its complete form the ball pattern is a *whorl*, with three deltas placed at about equal distances about it, but more commonly there is a modification of the pattern in which one or more of the deltas is missing, as in the case of the diagram (Fig. 4), where the pattern is the modification A in which the uppermost delta is wanting.

A *plantar pattern* may be either (1) a loop with an opening at the top; or (2) a loop opening downwards; or (3) a whorl, generally drawn out into an oval, as is shown in 2 in the diagram. Frequently these areas show no definite patterns, as in the case of 1 and 3 in the diagram. There are also occasional patterns which occur but seldom, such as the *fibular* or *outer pattern*, which usually consists of a narrow loop, H, not far below the area of the base of the toes. In some cases the core of the loop extends beyond the tread area.

Still more distinctive is the pattern on the heel, or *calcar pattern*, C, which is usually a simple loop associated with a delta, *d*. So rare is this pattern that less than a dozen instances of its occurrence have been recorded, and I am indebted to Professor Wilder and Mr. B. Wentworth for their permission to reproduce the examples here shown.

FIG. 4.—TRACING OF THE SOLE-PRINT OF A SMALL BOY.

Showing fibular loop (H) and the rare calcar pattern (C) which is always associated with a tri-radius (*d*).

(*By permission of Messrs. Wilder and Wentworth.*)

Fig. 4 represents a tracing of the entire sole-print of a small boy showing this feature, and photographs of actual imprints of calcar patterns, kindly sent to me by Professor Wilder, are shown in Figs. 5 and 6. The first of these (Fig. 5) is the heel-print of an American University Professor, which is unique in showing a complete loop, and the other (Fig. 6) that of an American woman. As Messrs. Wilder and Wentworth observe, the possessor of a calcar pattern is a marked man, and his imprint should be given a place of its own in any classification of sole-prints.

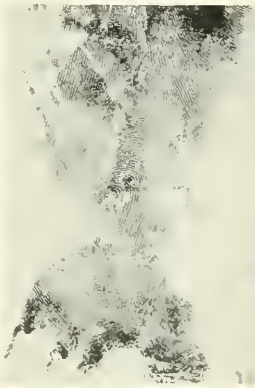


FIG. 5.

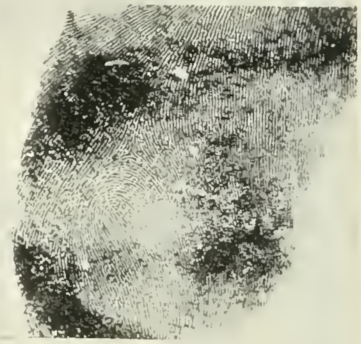


FIG. 6.

FIG. 5.—CALCAR PATTERN IN IMPRINT OF HEEL OF AN AMERICAN UNIVERSITY PROFESSOR.

This pattern is remarkable in showing a complete loop.

(*By permission of Professor Wilder.*)

FIG. 6.—CALCAR PATTERN IN IMPRINT OF HEEL OF AN AMERICAN WOMAN.

(*By permission of Professor Wilder.*)

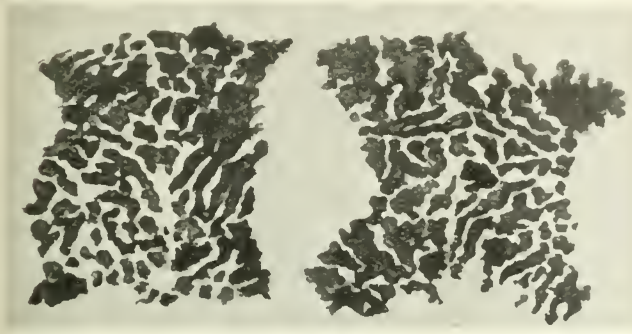
Although the registration of sole-prints is unlikely to displace finger-prints as an official method of general identification, there are many instances in which they would be of great value, as, for example, in the identification of portions of mutilated bodies.

The system is also much more readily applied than the finger-print method in the case of babies, and has already been adopted as a supplementary method for the identification of infants in the Chicago Maternity Hospital. For further particulars of the methods of using the system, reference may be made to Wilder and Wentworth's book on *Personal Identification*.

The Identification of Animals

The most recent development of the use of imprints from the ridges of the skin has been its extension to the identification of cows. It has long been known that the patterns on the fingers of lemurs and the higher apes may be as complex in their character as the human skin patterns, whereas the patterns of the ridges upon

the friction skin of the lower monkeys are much simpler in character. In the case of a ruminant animal, such as the cow, it would be useless to look for any characteristic patterns in the hoofs, but, acting on a suggestion sent to me from America, I have made a number of prints of cows' noses, and have found that the arrangement of the sweat pores follows distinctive patterns, which can therefore be used for the identification of these animals. The two accompanying prints (Figs. 7 and 8) were taken on December 22, 1922, from the noses of two young Jersey heifers belonging to



FIGS. 7 AND 8.—NOSE-PRINTS OF TWO YOUNG JERSEY HEIFERS, TAKEN DECEMBER 1922.

Mr. E. Matthews, of Little Shardeloes, Amersham, and may in future be of interest as the first prints of the kind made in this country. It is obvious that the patterns formed by the pores are quite distinct. The practical value of this discovery lies in the fact that it is not an uncommon practice for one cow to be substituted for another and more valuable one after the purchase has been completed. A registration of the nose-prints of all pedigree animals would therefore prove an effective safeguard against this fraud.

At the request of the Committee of the Royal Agricultural Society I am carrying out a further series of experiments to determine whether the patterns are permanent and remain constant in their form over a long period in the growth of the animal, and whether the differences are always as pronounced as in the case of these two animals.

It is quite possible that the same method of identification could also be applied to dogs, and, if so, it would be a very simple method of establishing their pedigree.

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The Artificial Feeding of Crops

By Sir E. J. Russell, D.Sc., F.R.S.

Director of the Rothamsted Experimental Station

EVERYONE is familiar with the idea of the feeding of animals, but it is not so obvious that plants also need adequate supplies of appropriate foodstuffs, without which they cannot continue to live. Indeed, in spite of man's long experience with growing plants, it was not till 1840 that any correct understanding of the subject was obtained. Farmers had of course known from the earliest days that farmyard manure was beneficial to plant growth, and that certain crops such as beans, lupins, etc., when dug or ploughed into the ground, enriched it for succeeding crops. But the mode of action and the effective substances were both unknown, and there was no general body of scientific knowledge to which an appeal might be made for help.

The oldest hypothesis was that the black, sticky substance in farmyard manure—the so-called "humus,"—constituted the food of plants: but it had not universally been held, and at least two distinguished seventeenth-century chemists—Glauber in Germany, and Mayow in England—had advanced evidence that the nitrate formed during the decomposition of farmyard manure was the essential fertilising constituent. The third hypothesis was advanced by Liebig in 1840 to the effect that the mineral constituents of the farmyard manure—the phosphates and the "alkali salts," potassium, sodium, calcium, and magnesium—were the true plant foods taken from the soil, all the remaining plant requirements being drawn from the air.

Lawes started pot experiments in 1839, but none of these hypotheses fitted his results, which indicated a strong need for nitrogen compounds as well as soluble phosphates and "alkali salts." To put the matter to a more serious test he and Gilbert laid out four plots of ground receiving respectively no manure; farmyard manure; ashes of an equal amount of farmyard manure; and these ashes + nitrogen compounds (ammonium sulphate). The results were as follows:

PRODUCE OF WHEAT PER ACRE. BROADBALK FIELD, ROTHAMSTED. 1844

	Grain. bush.	Straw. cwts.
No manure	16	1,120
Farmyard manure (14 tons per acre) . .	22	1,476
Ashes of 14 tons of farmyard manure . .	16	1,104
Ash constituents + nitrogen compounds (ammonium sulphate) up to . . .	26¼	1,772

The experiment showed then that farmyard manure owes its value, not, as was for long supposed, to the

organic matter, not to the ash constituents as Liebig had suggested, but to the ash constituents + nitrogen compounds.

The First Artificial Manures

With characteristic energy Lawes and Gilbert developed this discovery. There was then (as nearly always) a shortage of farmyard manure on farms, and agriculturists had for generations sought for substitutes, but with little success. Lawes and Gilbert saw that the mixture of ash constituents and nitrogen compounds would form an effective and more concentrated substitute, obtainable in very large quantities, and of course independently of farmyard manure. Vast deposits of calcium phosphate were known, and

Fig. 1.—Effect of Fertilisers on the Growth of Wheat.
The left-hand sheaf is the produce of the unmanured plot, the others show the effects of successive increases in the fertiliser given.

large quantities of ammonium sulphate were made in the manufacture of coal gas, while potassium compounds could be obtained without difficulty from wood ashes. Lawes and Gilbert therefore proceeded to extend their experiments with these substances, while Lawes set up the first factory for producing superphosphate. Farmers gradually came to recognise the value of these artificial manures, and before long they were using many thousands of tons a year.

When the Lawes and Gilbert experiments began the ordinary yield of wheat was about 20 bushels per acre: before twenty years had elapsed it had become 30 bushels per acre, and other crops had advanced in like manner. It cannot, of course, be claimed that the whole cause of the improvement lay in the artificial fertilisers, but this was one of the most important factors.

The story of the nitrogen compounds in their rôle of fertilisers reads almost like a romance. Lawes and Gilbert used ammonium salts obtained as a by-product in the manufacture of coal gas. Large quantities are now made every year; just before the war the world's production from all sources (e.g. coke ovens, etc.) was approximately 1,400,000 tons per annum. At Rothamsted and at many other centres 1 ton of ammonium sulphate brings about an increase of some $2\frac{1}{2}$ tons of wheat, so that the world's production, if devoted entirely to this purpose, would at this rate be equivalent to 3,500,000 tons of wheat. The quantity sounds immense, but when the large and growing population of the world is considered, it is not really very great. But the ammonium sulphate cannot be given wholly to wheat; other crops—potatoes, sugar-cane, animal foods, etc.—all need supplies of nitrogen.

A second source has long been known—nitrate of soda. This comes from Chile, and just before the war the world's consumption was 2,600,000 tons per annum. In some cases this material is better than, and in some inferior to, ammonium sulphate: on an average it is at least as good. The deposits are large, and the world could look forward with confidence to the future if they were inexhaustible; but they are not, and although the life of the beds has been put at 200 to 300 years, the period is not long in the history of the world. And as our own coal deposits must one day be exhausted, and with them the supply of ammonium sulphate, there is clearly the possibility that our present civilisation might perish solely for want of nitrogen compounds for the food of crops.

It is a familiar story how Sir William Crookes impressed these facts on the community in his address to the British Association at Cardiff in 1890, and how in consequence of his own investigations and those of the technical chemists and engineers who followed him, methods were elaborated for preparing nitrogen compounds from the air. Although this discovery also made possible the prolongation of the Great War, and was indeed used for that purpose, its beneficent effects are now showing themselves in the enormous developments taking place in the supply of artificial manures for human food crops.

Atmospheric Nitrogen

The best known of the new compounds is calcium nitrate, made in Norway by passing air through an electric arc and oxidising the resulting oxides of nitrogen and absorbing them in water, with formation of nitrous and nitric acids. The mixture is fully oxidised and neutralised with lime to produce calcium nitrate. The pure substance readily absorbs moisture from the air—a character which would be objectionable—an impure product is therefore sent out free from this undesirable feature. This product, known as nitrate of lime, has proved very valuable as a fertiliser, and

there is no question that it would serve as a source of nitrogen for all crops. Unfortunately the process requires considerable electric power.

A second method gives cyanamide. In this case calcium carbide is first formed by heating lime and carbon in an electric furnace; the carbide is then further heated in an atmosphere of nitrogen, when calcium cyanamide is formed. This is not itself a fertiliser, but it rapidly breaks down in the soil to give urea, which further decomposes to ammonia. This process requires less power than the other, but unfortunately cyanamide has disadvantages as manure: it is dusty and unpleasant in use; is apt to contain a substance toxic to plants, and does not invariably give the increased crop expected. In Central Europe (Switzerland, Germany, etc.) there are large cyanamide plants put up for the purposes of the war, but which could not without serious financial disturbance be scrapped; very vigorous attempts are therefore being made to overcome the disadvantages of this material. It is too early to say what results may be attained. It has been proposed to convert the cyanamide into urea or into ammonium salts, which could be sold alone or in admixture or combination with phosphates.

A third method gives ammonia direct by a catalytic process, and from the fertiliser point of view the cheapest product would be ammonium chloride. Experiments are in hand at Rothamsted to determine the fertiliser value of this salt as compared with the well-known ammonium sulphate. In wet districts and wet seasons there is little, if anything, to choose between them; in drier conditions the chloride is somewhat less effective than the sulphate. The chlorine ion bears possibilities of harmful influence on plants; when its concentration exceeds a certain value, both the yield and the quality of the crop suffer. These technical difficulties, however, are not insuperable, and the catalytic process remains as an effective contributor to the supply of nitrogen fertilisers.

Prior to the war the consumption of nitrogen fertilisers had doubled in ten years and the output had practically kept pace: since the war there has been serious dislocation in agriculture involving reduced consumption, but the productive capacity had more than doubled in less than the ten-year period. Reliable estimates of the world's production capacity in 1903, 1912, and 1920 are:

FIG. 2.—EXPERIMENTAL WHEAT FIELD, BROADBALK, ROTHAMSTED.
Showing plots on which fertilisers are tested.

	1903.	1912. Output. Long Tons.	1920. Productive Capacity. Long Tons.
Chile nitrate	1,429,150	2,586,975	2,966,061
By-product sulphate of ammonia	540,200	1,229,773	2,015,440
Fixation industry:			
Cyanamide	Nil	126,538	1,777,000
Arc process	Nil	75,000	254,300
Catalytic process	Nil	Nil	1,503,000
	1,969,350	4,018,286	8,515,801

Although many technical problems remain to be solved, it does not appear that any anxiety need be

felt as to supplies of nitrogen for fertilisers in the future.

The phosphatic fertilisers have an equally interesting history. Their value was predicted by Theodore de Saussure 120 years ago. During the first half of the nineteenth century the need was exclusively supplied by bones ground and added to the fields and pastures of England. When the demand became greater than the supplies from kitchens and butchers' shops of this country, there were large imports from abroad. It was said—and in view of the sources of supply it might be difficult to refute the tale—that the Continental battlefields were worked over to provide bones for the English market, and in one of Liebig's characteristic outbursts he anathematises England for her insatiable greed in hanging like a vampire round the neck of Europe, sucking the life-blood from the living and not sparing even the bones of the dead. It was Lawes' first experiment at Rothamsted that did away with the necessity for finding new sources of bones.

Geologists in the early forties had found large deposits of calcium phosphate in Spain and elsewhere on the Continent, and in the Eastern Counties of this country ; in 1843 Lawes showed that while these had little, if any, direct fertilising value, they became immediately effective if treated with sulphuric acid. In the chemical terminology of the day the product was called superphosphate of lime—a name which it still retains. This is now made in enormous quantities, the production exceeding 10,000,000 tons per annum.

Many years later—in 1884—it was shown that the slag obtained in the basic Bessemer converter had high fertiliser value, and right up to 1914, and indeed to some extent even yet, this slag was used with great effect on the grasslands of the country. But with the suppression of the Bessemer converter by the open hearth there has come a change in the nature and properties of the slag, necessitating careful technical experiments to find how the new material can best be used in agriculture.

It has been stated above that Lawes found the raw mineral phosphate to be ineffective as fertiliser. Further work has shown that this is largely a matter of fineness of grinding. With the highly efficient mills now available mineral phosphates can be ground so finely that some at any rate have high fertiliser value under certain conditions. In the Aberdeen district it has been shown that some of the mineral phosphates may be almost as effective as superphosphate. It does not appear that ground phosphates would generally prove as useful as superphosphate or basic slag, but there is evidence that in some conditions they are almost as good, and in many conditions they would find a useful place in the fertiliser scheme.

World Supplies of Phosphates

At present fears of phosphate exhaustion are remote. There are great deposits controlled by France in North Africa where the limits of the beds are not yet known ; there are also large deposits in the United States. But, curiously enough, the deposits are very local ; the far-flung British Empire contains none of importance so far as is known, beyond a few islands, the most familiar of which is Nauru. The African and United States deposits are being drawn upon to the extent of 6,000,000 tons per annum, and one wonders what will happen when the pressure of scarcity begins to be felt, as it inevitably must be. One could picture mankind struggling against phosphatic scarcity, suffering physical disease and mental deterioration as supplies diminished and became less and less able to solve the problem as the need became more and more urgent, till the final degradation and collapse of civilisation. But history shows that things never turn out as badly as might be feared, and we may be sure that some way will be found to overcome the difficulty.

Space does not permit more than a brief reference to the potassic fertilisers : these came exclusively from Germany before the war, but in part from Alsace now.

We must, however, turn to the work the agricultural investigator is called upon to do in connection with these various fertilisers. The general fact that fertilisers increase crop yields needs much modification when one descends to particulars. Weather conditions profoundly affect the response of crops to artificial fertilisers. One and the same fertiliser mixture which in one season gives results fully equal to, or even surpassing, those of farmyard manure, may on the same farm, and even in the same field, prove a failure in another season. The effect of soil is equally sharply marked.

Statisticians have during recent years been evolving methods for dealing with cases where several factors vary simultaneously. These methods have been applied by Mr. R. A. Fisher to the Rothamsted field data. He has been able to trace certain statistical regularities which foreshadow the possibility of important developments. Up to the present four factors causing variation have been disentangled and expressed quantitatively : they are slow changes in the field—such as changes in the amount of weeds, etc., deterioration of soil, weather changes, such as rainfall, etc.

The statistical studies, combined with the results obtained by the soil and plant investigators, open up the possibility of predicting crop yields when weather and soil conditions are known ; not indeed with absolute certainty, but with a specified degree of probability. Once this could be done, it would be possible to draw up tables showing the expectancy of

crop yields under given conditions, which could form the basis of insurance against low yields in the same way as mortality tables form the basis of ordinary life insurance.

Artificial Farmyard Manure

In spite of their great value in agriculture, the artificial manures have not proved quite as efficient over a period of years as farmyard manure; there has been more variation in yield, and they have not maintained the fertility of the soil so well as farmyard manure. The causes of this remarkable result are being worked out, but in the meantime a successful attempt has been made to find a solution of the farmer's problem and obtain more farmyard manure. Economic conditions prevent the making of farmyard manure in the usual way; it has been prepared at Rothamsted from straw by the agency of organic organisms and without the intervention of animals. Straw is watered with an ammoniacal solution (actually ammonium sulphate, but calcium carbonate is mixed with the straw), and the heap is kept moist so that the air can get in. The organisms then break down the straw and convert it into a black product looking very much like ordinary farmyard manure but without smell. This artificial farmyard manure is not yet equal to the natural substance, but it is steadily being improved and the very serious difficulties are gradually disappearing in Mr. Richards' capable hands. Five years ago a few ounces only of this artificial farmyard manure had been prepared; last year several thousand tons were made on different farms in various parts of the country. The serious problem of developing the work from the laboratory to the farm scale was possible through the generous and public-spirited action of Viscount Elveden. There seems here the probability of valuable aid to the farmer and of the development of an important new industry.

Some extraordinarily interesting results have been obtained by following up the discovery that farmyard manure and other organic substances of like nature are ineffective as fertilisers till they have been broken down by micro-organisms in the soil. Indeed, it may safely be said that the population living in the upper 6 inches of soil is as important to us as the larger and more familiar population of animals living on the surface of the earth.

BACTERIA AND THE SOIL

In the next issue of DISCOVERY will be published an article by P. H. H. Gray, M.A., of the Rothamsted Experimental Station, which will relate some of the results referred to by Sir E. J. Russell in his final paragraph. It will deal particularly with the utilisation for food of such disinfectants as carbolic acid by the bacteria of the soil. The importance of this subject to agriculturalists can scarcely be over-emphasised.—ED.

A Dimensional View of Music

By E. F. Bozman, M.C., B.A.

EVERYONE who listens analytically to music must be at times lost in wonder that the reverse process is possible—the process of synthesis from entirely intangible materials, within very few fixed laws, of a real and living entity which takes form as a musical composition. From the analytical point of view it is apparent that the three essential ingredients of musical matter are melody, harmony, and rhythm; these we may term the three dimensions in music, arbitrarily chosen as are the three dimensions in space, having an independent existence not in any concrete sense, but only in the mind of an observer. Music can be built up from these three factors, each of which may be considered as almost independent of the other two—almost, but not quite, for harmony can be thought of as having developed "contrapuntally," from the interlacing of several melodic forms, and conversely melody can be regarded as having arisen from some such essentially harmonic structure as a "scale." But whatever their origin, they have now grown to a strongly independent existence, and are at the disposal of the composer for him to mould to his design.

The Essence of Music

Melody is to music what line is to art; we can almost see the powerful lines of a Bach fugue, or the delicate tracery of a Mozart theme. Harmony is the colour of music; a rich chord impinged suddenly on a purely melodic passage gives the same shock of pure delight as is given by a daring splash of bright colour. Debussy knows how to administer these "cool, silvery shocks" more effectively, perhaps, than any other composer. And rhythm—we can carry the analogy no farther, for herein lies the vast gulf which is fixed between music and the other arts; music is dependent on the factor of time both in the conception and in the performance, is sequential, and has no meaning or existence apart from its beginning and its end, whereas the picture is static. Music is a cinematographic sound-picture, and rhythm is of its very essence; rhythm is, indeed, the groundwork and basis of musical art, the elementary structure on which the musical web is woven.

Let us assume, then, that melody, harmony, and rhythm are such stuff as music is made of, that they together form the whole. They, can, of course, be exploited individually, as, for example, melody was in the ballads of twenty years ago; harmony in the organist's vague improvisations which float through many a dimly lit church on Sunday evening; rhythm

in the jazz band: but the vast bulk of music which has stood the test of time contains an admixture of all three. The question we want to propound here is, have we, in order to explain the rather abrupt change or development in modern music, as opposed to classical, to add another factor to these three, or are we still within their bounds? Has a fourth dimension invaded the realms of music?

The Problem of Tuning

Before answering this we must consider some of the other facts of the case. The composer, in building his structure out of melody, harmony, and rhythm, is not limited by the innumerable combinations he can make out of these individually permutable elements—he can further diffuse his subjects among all the vast numbers of instruments of transmission, the voices, strings, winds, reeds, and brasses. Now these instruments all have very fundamental differences which arise largely from their different methods of tuning, and from the different overtones which they unavoidably produce. Let us consider for a moment the piano and the violin.

The tuning of the piano is a compromise by necessity from its rigid construction, for any one note has to do duty in all possible scales. Middle C must be the tonic in the scale of C, the major third in the scale of A♭, the dominant in the scale of F, and so on. It can only be nearly right for all these at once. Simple mathematics will show up this weakness of the piano in a very striking manner. The relationship between notes which combine to form a musical consonance is a simple arithmetic one; thus octaves bear the ratio 2 : 1, fifths the ratio 3 : 2. Now, if we start from the bottom A of a piano and impose fifth on fifth, we shall after twelve such intervals of a fifth arrive at top A, a super-octave of the note we started from, thus:

A E B F♯ C♯ G♯ E♭ B♭ F C G D A.

This process gives us an interval $\frac{3^{12}}{2^{12}}$,[1] which should represent a multiple of an octave, i.e. a power of 2.

But $\frac{3^x}{2^x}$ can never equal 2^y where x and y are integers, so that a piano, by virtue of the problem it has to face, can never be exactly in tune.

The violin presents quite a different problem, for here the player can alter his C slightly at will, to suit the scale he is playing, and is only prevented by an imperfect ear or faulty technique from being always perfectly and mathematically in tune. His overtones, too, are variable by his use of the bow, while in a piano the string is struck at a fixed point which determines a "node"[2] for that string once and for all. Thus there arise two different systems of tuning—"equal" (or compromised) tuning and true tuning—which give another variable factor to music; may we call it the fourth musical dimension?

The Trend of Modern Music

To revert to our modern music. The music of to-day does not probably make much conscious use of this fourth dimension. From a practical point of view music still exists fundamentally on melody, harmony, and rhythm, and its chief distinction from classical music arises from *progress* rather than *revolution*. Harmonic forms are less restricted, the use of harmony and rhythm is more fully understood—consider Ravel's perfect mastery of rhythm—and modern ears are trained to appreciate more obscure melodies. The modernism of Schonberg and Bax are presaged in Schumann and Bach, but the former can write for a more highly trained audience, can make elisions and "musical assumptions" which would have been unlawful at an earlier stage in the development of the art. Modern orchestras are more varied. But the finer shades of dissonance are asserting themselves, and composers already appreciate the fact that combinations which sound right on the organ or piano, sound wrong on the orchestra, and vice versa. Quarter-tones are being talked of, and there can be little doubt that, as ears become more finely developed, the question of tuning will be an all-important factor.

This point may be illustrated roughly in another way. The extraordinarily thrilling effect of a number of violins in unison must have been felt by many—an effect which cannot be produced by any mechanical magnification of one violin. This, then, must be due to the fact that all the violins are slightly out of tune with each other, and the ear appreciates only subconsciously this fine shading. The curious jar of a piano or an organ in a concerto is another example of the same effect.

This clash of sounds of different shades rather than of different pitch undoubtedly plays a most important part in the emotional appeal of music, but this brings us to an aspect of music which is quite outside the scope of this article, an aspect which avowedly remained a mystery to Beethoven and Wagner themselves. For above and beyond the phases which we have attempted to analyse lies the great power which music has in common with all art, of transcending the substance whence it is created, and reaching to the secret places of the heart.

[1] This interval works out actually to 129·7 instead of 128, which would accurately represent seven octaves.

[2] A string vibrates in segments, the points of maximum oscillation being divided by points of rest or minimum oscillation called "nodes."

Crystal Gazing Ancient and Modern

By W. R. Halliday, B.A., B.Litt.

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A FAVOURITE method of foretelling the future, and one which has enjoyed a considerable continuous popularity, is the observance in a mirror or bright object of past, present, or distant happenings. The most usual instrument to-day employed for this purpose is the crystal, but the place of the ball of glass may equally well be taken by a bowl of water, a pool of ink, oil, or fluid, a smear of lamp-black, a mirror or bright metal object, or, I imagine, a bright light. For the function of the instrument in reality seems to be the induction of a hypnotic state by prolonged concentration of the eyes upon some bright or dazzling object. This physiological phenomenon is perhaps in part responsible for the magical powers attributed to crystals by Australian natives and other primitive peoples. I believe that in modern spiritualistic theory no particular magical efficacy is attributed to the crystal itself, and that the normal practice is for the *clairvoyante*, after being placed in *rapport* with the object of inquiry (e.g. by being given some article associated with the person about whom inquiry is being made), to throw herself into a hypnotic state by gazing at the crystal and in this condition to exercise her mediumistic powers. Viewed historically, this is but a recent theory of the efficacy of crystal gazing, which seems originally to have been based upon the supposed magical property of the instrument in which the reflection of the future appeared rather than upon the peculiar sensitiveness of the operator in a hypnotic condition. In modern practice it is usually the *clairvoyante* alone who sees the vision; in the earlier history of the rite it is more usually the inquirer himself who sees it, thanks to the magical power of the crystal or of its possessor. The magical crystal, however, has not completely disappeared. In 1909 the newspapers reported a coroner's inquest upon the wife of a Cardiff postman, who committed suicide by inhaling gas. Evidence was given that the unfortunate woman had recently returned from a visit to a fortune-teller, and had told her stepfather that, "when she asked me to look in the crystal, I saw myself seated in a chair deliberately committing suicide with gas." Here the inquirer herself looked into the magic mirror and received the fatal suggestion upon which she acted.

With the magic mirror is connected the magical well in which distant objects or events may be discerned or the death or recovery of sick persons be revealed. Such waters of divination were known in classical antiquity. At Tænarum in Greece there was a well in which people who looked into the water could see the harbours and the ships. Unfortunately a woman defiled the spring by washing dirty clothes in it and, when Pausanias visited it in the second century after Christ, it had consequently lost its magical properties.[1] Anyone who looked into the water of a spring of Apollo near Cyaneæ in Lycia would be shown whatever he wished to see. A mirror-spring at Constantinople, which presumably possessed similar qualities, is mentioned in the seventeenth century by the Turkish traveller Evliyá.[2]

The Holy Well

At the sanctuary of Demeter at Patræ in the Peloponnese was a holy spring which in classical times foretold the event in cases of sickness. A mirror was let down by a fine cord so that it just grazed the top of the water. (With this artificial improvement of the reflective powers of the water we may perhaps compare the practice of finishing the surface of the bowl of water used for divination with oil, an instance of which is mentioned below.) The inquirer prayed to the goddess, offered incense, and then looked into the mirror in which he would see the sick person reflected alive or dead. In the second century of our era Lucian narrated a similar wonder in his *Veracious History*, a satirical parody of histories based upon travellers' tales. In the palace of the King of the Moon his hero saw a great mirror over a well of no very great depth. If one goes down into the well one hears all that is being said amongst us here on earth, and if one looks in the mirror one sees all cities and nations. He tells us that he himself saw his relatives and all his native land, and adds that "whoever does not believe that it is so, if ever he goes to the place, will know that I am speaking the truth." The magical mirror-well is not unknown to English folklore. For instance, girls who walk backwards on St. Mark's Eve to the Maidens' Well at North Kelsey, in Lincolnshire, and then three times round it, are able to see reflected in the water the features of their future husbands.

Both in classical antiquity and in modern folklore

[1] It is a common belief that the magical properties of elements or objects may be destroyed by impure or improper use. For example, in Axó, a village on the Cappadocian plateau, I was told in 1910 that there had formerly been a curative spring (ἁγίασμα) below the tomb of St. Macrina, which is a local centre of pilgrimage (see Carnoy and Nicolaides, *Traditions Populaires de l'Asie Mineure*, p. 204). When I was there, the cistern, into which it had trickled from the rock, was dry and the cause was said to be the action of a renegade woman who had turned Turk. She washed her baby in the water, whereupon it had ceased to flow.

[2] Von Hammer, *Narrative of the Travels in Europe, Asia, and Africa in the Seventeenth Century by Evliyá Efendi*, I, ii, p. 46.

the magical mirror, a more portable and convenient instrument, has performed functions similar to those of the magical well. Apuleius, the famous author of *The Golden Ass*, who was brought to trial on a charge of magic in the second century after Christ, was accused *inter alia* of using a magical mirror. In the seventeenth century Glanvil reports how Dr. Compton, asked by Mr. Hill whom he desired to see, took up a looking-glass that was in the room and showed him his wife in it.[1] It is a common English superstition that upon St. Andrew's Eve maidens may behold the faces of their future husbands reflected in their mirrors.

Instead of a looking-glass, a receptacle containing liquid may be used. Thus in the *Acharnians* of Aristophanes, which was first put upon the stage in 425 B.C., the fire-eater General Lamachus and Dicæopolis, the hero of the party of peace-at-any-price, divine against each other. Lamachus pours oil into the hollow of his shield and reports the vision of his opponent being punished as a deserter; Dicæopolis pours honey on his plate and sees in it his happy and prosperous self trouncing Lamachus. A well-known Cornish wise man of the first half of the nineteenth century detected thieves by showing their faces in a tub of water, and a certain Scotch magician named Willox possessed a magic stone which he dipped into a basin of water in which the thief's face was then reflected. I think I am right in saying that the celebrated Dr. John Dee, who certainly also employed a magic mirror, made a similar use of his holy stone which is now in the British Museum, but I cannot recall the source of my information.

All these examples are similar in so far as the desired information is directly reflected in the instrument employed. The process is frankly magical, and its efficacy depends upon the magical property of the instrument, the magical powers of its possessor, or the magical season at which the inquiry is made.

Calling Up Spirits

This direct method, however, is too simple for more sophisticated patrons of superstition, and both in later classical antiquity and in the divinatory practice of Christendom and Islam a more elaborate theory became popular. According to this the water, ink, mirror, or similar instrument merely serves as the vehicle for the manifestation of some divine or spiritual agency. The spirit of a dead man, a god, a Jinn, or an angel is invoked, is often made to manifest itself in the crystal or mirror, and then either causes a picture of the required information to be reflected, or itself directly answers or in some way indicates the answer to the questions.

In later classical antiquity, when various forms of necromancy enjoyed an especial popularity, the spiritual agents invoked were often the spirits of the dead, and in one passage St. Augustine speaks of hydromancy (i.e. divination by a bowl of water) and necromancy as convertible terms.[2] More usually the agents were gods or spirits. Thus St. Augustine explained to his own satisfaction the legend that Numa, the reputed founder of Roman religious institutions, received divine assistance from the water-nymph Egeria, by supposing that God permitted him " to see in water the images of gods or rather the mockeries of demons " from which he acquired his ordinances. The magical papyri sometimes give instructions for the variations of ritual procedure proper to the various kinds of spirit invoked. " When you wish to be informed about matters, take a brazen vessel or dish or phial of any shape you like and put water in it. If you invoke the heavenly gods, rain water, if the earthly, sea water, if Osiris or Serapis, river water, if the dead, spring water." In the magical prescription here quoted the god, upon his appearance, is asked the questions and directly answers them. An instance of prophecy by a boy contemplating a reflection of the god Mercury in a bowl of water is attested by Varro in the first century B.C. Mechanical devices were sometimes employed by charlatans to produce the appearance of the god or spirit in the bowl, and the Christian Father Hippolytus, in the third century, refers to such pieces of conjuring apparatus. In some cases, however, the image of a god was openly engraved upon the bowl as part of the ritual and with no intent to deceive by a fictitious apparition. Thus in one of the magical papyri " You take a bowl of bronze, you engrave a figure of Anubis in it, you fill it with water . . . you finish its surface with fine oil, you place it on three new bricks, their lower sides being sprinkled with sand; you put four other bricks under

[1] Joseph Glanvil (1636–80) was chaplain to the Provost of Eton in 1658 and a staunch upholder of the Commonwealth. His political opinions, however, underwent a change upon the accession of Charles II, and his published recantation pleasantly entitled *The Vanity of Dogmatising* gained him a Fellowship of the Royal Society. He was a friend of the Caroline antiquaries Aubrey, Lilly, and Anthony à Wood, and he became chaplain to Charles II. His *Sadducismus Triumphatus* is the definitive edition of his series of writings as a convinced supporter of the reality of witchcraft and the existence of witches against the enlightened doubts of Webster and Reginald Scot.

[2] The Byzantine scholar Tzetzes similarly thought that the visit of Odysseus to the Lower World (see DISCOVERY, iv, p. 9) was a poetical embroidery on the fact that Odysseus had really consulted the ghost of Teiresias by hydromancy. In Turkish Constantinople there was a Well of Souls which would answer any question save those relating to the five hidden things, which, as the Prophet declared, nobody knows but God. (One of these is the sex of the unborn child; what the other four are I do not know.) Evliyá himself tested its power successfully. Its name suggests that spirits of the dead were agents; on the other hand, the preliminary prayers were devoted to the merit of the Prophet Yussuf (Joseph). (Von Hammer, *op. cit.*, I, ii, p. 34.

the child, you make the child lie down upon his stomach; you cause him to place his chin on the brink of the vessel; you make him look into the oil, he having a cloth spread over his head, there being a lighted lamp on his right hand and a censer on his left." Further ritual preliminaries follow. "When you have finished, you make the child open his eyes, you ask him saying 'Is the god coming in?' If he says 'The god has come in' you recite before him"—an incantation of the ordinary type (see DISCOVERY, iii, p. 99) here follows—"you ask him concerning that which you desire. When you have finished your inquiry, which you are asking about, you call to him seven times: you dismiss the god to his home."

A Yorkshire Incantation

In Christian Europe angels or devils have been the agents most usually invoked. Thus a Yorkshire wise man used the incantation "I command ye, exorcise ye, the archangels Michael and Gabriel, that ye make Mark Jobling's shop to appear in the glass and also the likeness of the thief or thieves so that they may be seen and identified." On the conclusion of the incantation, he said, "Presto! quick begone!" whereupon Mark Jobling's shop and the thieves appeared in the glass. Similarly in the formulæ for divination by the crystal or the phial of holy water, which are quoted in Reginald Scot's *Discoverie of Witchcraft*, the spirits first appear and then conjure up the required scene. In Mohammedan countries the place of angels or devils is naturally taken by Jinni, who give information sometimes by the indirect method of causing a reflection of a required scene and sometimes by direct answer like the gods of the magical papyri. Thus an Arab magician in the Malay Peninsula invoked a little old Jinn into a bowl of water into which a written charm had been dipped. The Jinn first appeared and then caused a pictorial reflection of the event required. In the Panjab the normal instrument seems to be a pool of ink dropped upon a written charm in which a small boy is instructed to gaze. He summons first the Four Guardians. When they appear he instructs them to summon their King. When the King appears the questions are put to him and answered by him through the child, who alone hears or sees the spirits.[1]

A similar and even more elaborate procedure recorded by Professor Browne in Persia is of particular interest, because his informant had himself taken part. "Now you must know that the operator cannot himself see the force of the Jinn whom he evokes: he needs for this purpose the assistance of a young child. I then being quite a child was selected as his assistant. The magician began by drawing a talismanic figure in ink on the palm of my hand, over which he subsequently rubbed a mixture of ink and oil, so that it was no longer visible. He then commenced his incantations: and before long I, gazing steadily, as I had been instructed to do, into the palm of my hand, saw reflected in it, as it were, a tiny figure which I recognised as myself." This figure he was told to address in a peremptory manner and bid it summon the King of the Jinni. A second figure then appeared, but the boy became frightened and rubbed the ink off his hand. Another boy was, however, procured to take his place. After the King of the Jinni had appeared, his Wazir was summoned and then the other members of the Royal Council of the Jinni, and they were bidden to be seated. The operator then took slips upon which the names of members of the household were written: as he took up each slip the boy looking into the ink-mirror read therein the name which was written upon the slip until one was reached, when the boy, instead of the name, could only see the text "In the name of God, the Merciful, the Clement." The name upon this slip indicated the person guilty of the theft about which inquiry was being made.[2]

BIBLIOGRAPHICAL NOTE

A useful bibliography of the literature dealing with the use of mirrors in classical magic is given in Abt, *Die Apologie des Apuleius von Madaura*, p. 25. The references for most of the examples here given will be found in my little book on *Greek Divination*, pp. 150 foll. I have here quoted references only for the examples which are not there recorded.

[1] Crooke, *Herklot's Islam in India*, p. 264.

[2] Browne, *A Year amongst the Persians*, pp. 146–7.

Forests and Fertility

By Colonel H. de H. Haig

It is one of the unfortunate results of civilisation that while it enables men to live in much larger numbers on the ground, they can only do so by annihilating other forms of life. In this way, man has ruthlessly destroyed trees to make his houses and to make way for his flocks, without considering what effect their destruction may have on the climate and resources of the region he lives in. This point never was considered until the increasing ill effects forced themselves on man's notice, by curtailing his means of livelihood. It cannot be altogether accidental that where mountains and uplands have been denuded of the forests which naturally clothed them, the results have always been destructive floods in the rainy season and shrivelled-up rivers in the dry. There may be other cosmic causes underlying these phenomena, but as the sequence always appears, the denudation of the trees must be at any rate a contributing cause, if not the main one.

Most people have noticed that on the hottest day a

growing leaf is always cold, the reason being that the plant has discovered exactly what amount of moisture it is necessary to evaporate from its pores to keep its temperature down. Humanity does exactly the same thing when it is properly acclimatised. In the hottest climates, the natives' skins are normally as cold as a snake's, whilst the visitor is streaming with useless perspiration, too profuse to evaporate. The plant has to absorb water through its roots from the ground, so that if it cannot penetrate deep enough to get sufficient moisture, it dies. The leaves of a tree are always cool and evaporating moisture, and it follows that every breeze that blows over them is cooled and moistened, which means that the dew-point has been lowered. If the wind now encounters a hill-slope, on blowing up it the dew-point is still further lowered by the chill caused, and rain is all the more likely to result. The ground also under the tree is shaded from the sun, and is therefore cooler and moister than if it were exposed. In addition, when rain falls, it is easily conducted down the holes made by the roots into the soil, and there is not so much left on the surface to run off or be lost in evaporation.

In the other case, when there are no trees, the soil gets very hot and dry, and the herbage, having roots that do not penetrate so deeply, gets parched. Since the ground surface is caked, any rain runs off freely, and as the earth has been baked hot by the sun, there is much loss in evaporation. More than this, since the quantity of water running off is so much larger, its scoring and carrying powers are much greater. The result is that a great quantity of stones, earth, humus, and detritus is always swept off slopes that have been deforested, filling up and choking the river-beds, whereever the slopes are too flat to enable the current to carry it farther.

A good example of this is the port of Pisa. For fifteen hundred years at least, the mouth of the Arno was a port which supported a wealthy town. Later, the town grew into a state, rivalling even Genoa. It had colonies in Majorca and Minorca, an army and a navy with which it fought its neighbouring states.

Effect of Cutting the Apennine Forests

In the fourteenth and fifteenth centuries the Apennines became deforested, some say because it was believed that the devastating plagues of the Middle Ages were caused by trees, or it may have been to get more pasture for the growth of the wool which made Florence so rich and famous. At any rate the result was disastrous. The Apennine pastures dried up, the rivers rapidly rose in flood and carried more and more gravel down to the sea. The harbour of Pisa became choked and obliterated, the Pisans ignorantly blaming the Genoese for having done it in one of their raids. Now there are miles of unhealthy marshes between Pisa and the sea, and there is no harbour for even a row-boat to shelter in, and this is all traceable to the ground getting hard and caked in the absence of trees.

Where there are forests the soil is filled with water which is kept cool, and, therefore, the springs are well supplied, keeping up the flow of the rivers for a longer time and at a higher level. At the same time the surface of the subterranean reservoir is kept higher, and the roots of plants and trees have a better chance of getting their necessary moisture from it. Without the forests, rain rushes off rapidly, causing severe floods, masses of gravel and detritus pour over fertile fields, followed by a rapid fall in the flood level. A shrivelled current is all there is for most of the year in a vast bed of gravel, which is quite useless for agriculture because it is covered with water so frequently. The subterranean reservoir falls then to a much lower level, and the surface plants and trees consequently suffer accordingly.

Saturation Level

In every country this subterranean reservoir exists at a greater or less depth below the surface. It is the level of saturation which, of course, varies from time to time according to the rainfall. At the sea, it coincides with the mean tide level, but it rises more and more on going inland, and it is the level to which wells must be sunk before water appears in them. It is caused by the rain, which is usually said to run off to the extent of one-third ; another third sinks in to form this reservoir, and the remainder is lost in evaporation. When following a river valley, one often notices a line of springs appearing at a certain level ; this is when the valley has been cut down to below the subterranean reservoir, which then forms a wet trough for it to run in. When the reverse is the case, the river loses a great deal of its water by its percolating into the dry soil around and beneath it. In the East this last is very common, so that rivers very often get smaller and smaller the farther they go, till at last they dry up altogether.

We see now that the denudation of trees has cumulative ill effects which tend to reduce the fertility of the country. The reverse is also the case ; a large growth of forests has accumulative good effects tending to greatly increase the humidity of the air, the equability of the temperature, and the fertility of the region. The moisture in the atmosphere, largely supplied by leaves, has a very great, but often unnoticed, effect on a climate. The aqueous vapour is impervious to heat rays, unless they come from a greatly heated source. In fact, it acts in much the same way as glass. The heat rays from the sun pass freely through, but when the same rays are reflected back from the earth, the

glass or the water vapour acts as a screen to them. The atmosphere in this case is just a blanket like the roof of a greenhouse, with all the benefits which naturally accrue from it. This is the main reason why moist climates are so much more equable than dry ones. In a desert the day temperature often rises to 120 degrees or even 140 degrees Fahrenheit in the shade, while at night it may fall to below freezing-point. In a moist climate in the same latitude the daily range will be perhaps from 80 to 85 degrees shade temperature in the day, and 65 to 70 degrees at night. The hotter the climate the more marked are these effects. In the moist climate of Bengal, in the forested parts, the thermometer scarcely ever reaches 90 degrees in the shade, whilst at night it is rarely below 80 degrees. In the same latitude in Bikaneer Desert or in the Sahara, the temperatures have a diurnal range of perhaps 70 degrees or 80 degrees instead of 10 degrees, and this is entirely due to the presence of moisture in the air. It follows, then, that the hotter the climate the more careful man should be to preserve his trees, but unfortunately exactly the reverse is usually the case, either from ignorance, want of fuel, or shortness of pasture.

Damage by Animals

It usually happens that when a country is deforested, goats and camels are turned on to the land. Any live roots are speedily grazed out of existence, seedlings are destroyed, and the humus pulverised and scattered. Then the replanting is a difficult and expensive job. If it happens to be a country without summer rain, such as Sicily and the Mediterranean shores have become owing to the influence of the Sahara, no seedling can get its roots deep enough in one season to stand the desiccating effect of the summer drought, which may penetrate a couple of feet. Only the planting of young trees of larger growth can then be effective, at, of course, a much enhanced cost. The downward grade is cumulative ; the longer the replanting it put off, the more difficult and expensive does it become.

One of the effects of deforestation is to accentuate the drying due to atmospheric circulation acting on the present distribution of water and land on our globe. The result is the menacing increase in the desert areas of the earth.

Only lately it has been found that, notwithstanding all that we have done in Egypt with dams and canals, there is now a shortage of water ! The Government has sent an expedition to examine the sources of the Nile, and to decide if anything can be done to increase and conserve them.

Equatorial rains are usually very heavy, but they have a long way to run to reach Egypt. The loss by evaporation and by seepage on the way from Abyssinia is very great. As the countries through which the Nile runs gradually dry under the malign influence of the Sahara, so the level of the subterranean reservoir lowers, and the more is the loss to the river flowing above it. Once upon a time, when a race of palæolithic savages lived in Egypt, that country was blessed with abundant rainfall and luxuriant vegetation ; that is admitted by all geologists and archæologists. It is easily seen to have been the case by the valleys and gulleys cut by water which run down to the Nile, but are now dry. The famous Valley of the Kings, where Lord Carnarvon's wonderful treasure tomb has been found, is a case in point. There a short stream, a few miles in length, has been so full and strong that it has been able to cut a channel at least two hundred feet deep in hard limestone rocks, leaving beetling precipices that once bordered the current, but now afford starting places for the tomb galleries.

It is unfortunate that the animals that man domesticated in hot countries should have been the worst possible in abetting him in the destruction of trees—camels, donkeys, goats, all eat branches and leaves of growing trees as high as they can reach. What chance has a young tree of growing up ? The tall old ones die and are not replaced, so deforestation goes on apace, man in his ignorance being his own enemy.

Not Yet Too Late

Our task is to make our earth comfortably habitable for the largest number of human beings it can hold. To do this, it is of the greatest importance to cover the soil where possible with a canopy of leaves, so as to regulate the gradual distribution of the rain that falls. It is not yet too late for man to begin covering the waste places of the earth with trees. Probably, if left to themselves, many of them would regain their forests. In former ages, when all vegetation had been destroyed by cold and ice in glacial periods of continental ice, the forests regrew themselves time after time. Man can accelerate the process as was done by the late Lord Armstrong, who planted over three million trees with magnificent enterprise, when he was over fifty years of age. He lived to see many of them one hundred feet high and four feet in diameter. He proved that, by scouring the arboretums of the earth, it was possible to obtain much finer results than by trusting to the local growths.

A great deal can be done in conserving our growth, as is shown by the fine foresight of a certain newspaper. It was found that trees of thirty years' growth were suitable for paper, and that an area of so many acres was required for a year. Thirty times this area was bought in Newfoundland, one-thirtieth of it is cut every year and at once replanted. The water of a lake and waterfall is used to turn the wood into pulp suitable

for paper. There an enterprise was created which should go on indefinitely year by year.

In Germany every slope that is too steep to plough, every acre too cold to farm, is planted with suitable trees. When cut, these are replaced by a definite rotation of varieties, and thus an immense and profitable industry brings benefit to the State. Every year, timber augments in price as the civilised population grows, and its appetite for wood is continually larger and larger. We are not far from a timber famine, so it behoves every Government to follow the good example set us by our late enemies, who now find, with a collapsed exchange, the enormous advantage of having a good timber supply at their own doors.

The Improved Chromoscope

By Daryl Klein

The chromoscope is not described in the dictionary. It has escaped the attention even of many who are tolerably well acquainted with the numerous -scopes one finds depicted in scientific textbooks. In optical research circles, the functions of this instrument are not uncommonly known. And it is true that its name gives a clue to its applicability. Nevertheless it has remained discreetly in shadow for some sixty years.

In 1862, when the history of the chromoscope begins, we can imagine an observant optician gazing into a shop window. As he stands admiring its contents, the sun comes out, and great is his astonishment to see the traffic in the street moving, apparently, in the shop window. Fact or phantasy, wonderful enough in all truth to set him thinking, but a moment later behold him bewildered to observe a top-hat poised on the moment-since-bare head of a wax mannequin.

It may be admitted that our optician was favoured in the form of his illusion, but nearly everyone can tell of the same experience. It arises, as the optician no doubt reasoned, from the fact that the window reflects as well as transmits light. The two images so produced appear coincident in space, although the rays which make the two objects visible reach the eye by quite different paths.

This is the underlying principle of the chromoscope, a principle employed in "Pepper's Ghost" and numerous other optical illusions which delighted Victorians. The shop window serves as a two-picture chromoscope, although perhaps not a very good one. It is clear that, if our optician had stood on the far side of the street, the hat on the mannequin's head would have looked ridiculously small. In order to make both objects appear on the same scale, the optical paths by which they are viewed must be equal. And, we can conjecture, it was this reasoning which led Ducos du Hauron in 1869 to construct the first chromoscope intended for use in connection with three-colour photography. In Paris in the same year, Charles Cros described a "photo-chromoscope" which, according to him, would prove of considerable service in finding a "solution du problème de la photographie des couleurs."

For a reason which will be touched upon later, no further application for the chromoscope was found. F. E. Ives, whose name is associated with the "original" chromoscope (1895), was himself an advocate of its use in colour photography, and his simple design has served as a model for most chromoscopes constructed since.

Fig. 1 shows the essential part of Ives's instrument.

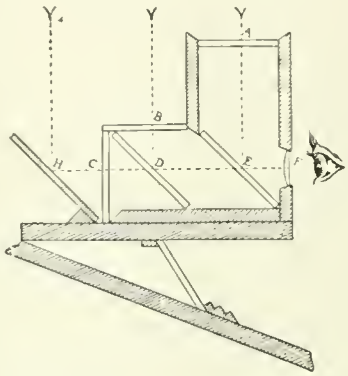

Fig. 1.—An early chromoscope.

A, B, and C are sheets of red, blue, and green glass respectively, on which the three positives are placed. H, D, and E are transparent mirrors, and the three positives are so arranged that the distance traversed by the light in passing from each positive to the eyepiece is the same. So that the three differently coloured images appear to coincide and give rise to a single-coloured image.

It is conceivable that, using this method, we could build up an instrument to take almost any number of slides, but, if transparent glass mirrors are employed, a serious difficulty arises. Reflection takes place at both surfaces of the glass, and each image is therefore accompanied by a secondary image, slightly smaller and farther from the eye, and considerably fainter than the primary image. In the case of the three-picture chromoscopes, these images are not of very great importance, but the multiplicity of images arising from the cause in, say, a ten-picture chromoscope would be very distracting. In addition,

the loss of light by absorption would be considerable, and allowance would have to be made in constructing the instrument for the displacement of the images by refraction.

These were the defects which prevented the further development of the chromoscope and its application to uses other than that for which it was originally devised ; and, indeed, it seemed likely that the chromoscope would remain exclusively at the service of colour photography.

Quite recently, however, Messrs. Adam Hilger, in the course of cunning research in optical fields of science, discovered that an extremely thin and tightly stretched film of celluloid served equally well as, in fact much better than, glass as a transparent reflector. Of a thickness little greater than the wave-length of visible light, its sensitivity was put to use in their optical synometer and various other instruments of Adam Hilger design. All the defects inseparable from the employment of glass mirrors were now eradicated. But it was not until Adrian Bernard Klein, artist and colour physicist, turned his mind to this discovery that its application to the chromoscope came to light.

Adrian Klein, skilled in the matching and the music of colour, knew the defects of the chromoscope ; and, not slow to grasp the corresponding significance of optical celluloid, caused a ten-picture instrument to be built. In this instrument he made use of ten celluloid mirrors in which the formation of secondary images was successfully avoided.

In this manner the chromoscope was freed from the shadow in which it had lain for sixty years, and its history entirely changed.

New Developments

An instrument enabling all sorts of coloured designs to be viewed immediately in any desired colour combination, the chromoscope now enters an indefinitely enlarged sphere of usefulness. It is called the "Improved Chromoscope," and its province, far from being limited to three-colour photography, covers textile printing, wallpaper printing, weaving, chromo-lithography, and numerous other manufacturing processes which make use of coloured design.

Before hinting at the possibilities in this field, we must first describe certain modifications in construction (apart from the celluloid mirrors) which now make it so comprehensive an instrument. These can best be understood by reference to Fig. 2, which shows a perspective view of a ten-picture instrument.

It will be seen that the instrument is divided into a number of compartments. Each compartment contains (S) a lamp the height of which can be adjusted so as to vary the brightness of the corresponding image ; (D) a piece of ground glass to diffuse the light and to obtain even illumination of the positive : (N) a slot in which a holder containing the positive can be placed (a "filter" of any desired colour can be placed between D and N). In addition, each of the compartments on the right-hand side of the instrument contains a celluloid mirror (C) inclined at 45 degrees to the horizontal, and (M) a horizontal silvered mirror.

Considering the compartment nearest to the observer, it can be readily seen that the light passes through the filter to the positive. It is then transmitted through the celluloid mirror, reflected from the

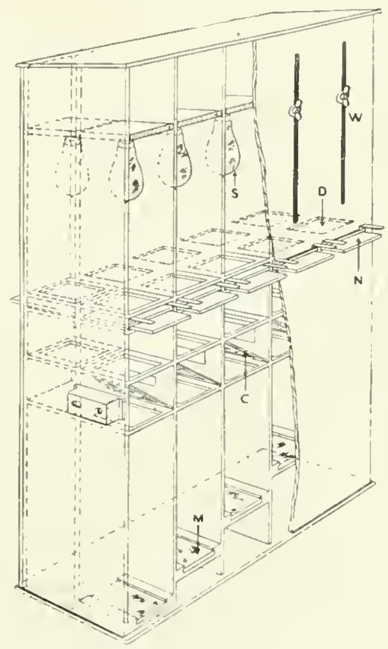

FIG. 2.—THE IMPROVED CHROMOSCOPE—OPTICAL SYSTEM.

silvered mirror, and finally reflected from the underside of the celluloid mirror to the eye-piece. The optical paths by which the remainder of the positives on the right-hand side are viewed can be traced in a similar way, and it will be seen that if the vertical distance between successive horizontal mirrors is half the horizontal distance between the successive inclined mirrors, the conditions as to equality of optical paths will be fulfilled.

The arrangement on the left-hand side of the instrument is slightly different, and the images are viewed from the eye-piece by means of two vertical silvered mirrors (not shown in Fig. 2), each making an angle of 45 degrees with the end of the instrument.

With this brief outline of the optical system, we are now ready to see by what means the colours of the combined parts of the picture are altered. Taking the case of a calico print design, a separate drawing or impression is first made of each separate colour element. From these drawings, a set of lantern-slide

negatives is made. These negatives are then placed in the slides of the instrument, and colour filters, placed above them, change the light illuminating the various slides. A coloured representation of the design is thus arrived at, and the scheme of colouring is varied simply by changing the filters. Indefinite variation in colour and intensity is provided by a set of some ninety-five filters which, singly or combined with one another, cover the entire chromatic range ; and degrees of brilliancy are produced both by superimposing neutral-grey filters and by adjusting the height of the light-source. By these simple means it is possible to obtain any imaginable colour-scheme, and to brighten or tone down the component colours to any desired intensity.

Colour Harmony Problems

Let us now glance at the untilled fields which lie before this remarkable evolution of a mid-Victorian's beholding in a shop window.

Released by Adrian Klein's ingenuity from limitations which have kept it uniquely associated with three-colour photography—in the shadows sixty years—it emerges suddenly an instrument of great industrial value, an active agent designing a further development in our sense of things artistic and beautiful.

The fact that the artist or designer can project a colour scheme in a few minutes, and change it again and again with a movement of the hand, is perhaps the most arresting function of this instrument. In all processes involving colour—printing, painting, weaving—the presentation of the colour itself is generally the most difficult and arbitrary factor—a factor exposed to misinterpretation and change, and at the mercy of the varying light under which the process is carried on. The painter, for instance, employs a variable medium. His pigments, never so deftly transferred from the palette to his canvas, undergo a change during transference. He must mix and remix in order to repeat a certain shade or intensity. The light illuminating his canvas changes the painted colours from moment to moment. The ever-changing conditions, chemical and optical, evade finality in his task.

This finality, so earnestly desired by artists of every calibre—particularly by the "commercial" artist, the realisation of whose painting must be final in printed or woven form—is achieved by the Improved Chromoscope. Here is provided for the first time a means of fixing, altering, and refixing in steady vision patterned rays of decomposed light—colour whose presentation has hitherto been elusive and accidental.

Apart from the artist and student, there are the commercial elders, the manufacturers, into whose field the Improved Chromoscope comes with quickening promise and increased powers. Chief among these is the textile printer. How aid might be given him suggested itself last year to Adrian Klein, who is adviser on colour physics to the Calico Printers' Association, Manchester, and we have seen that aid take shape. The suggestion came to him through direct observation of the conditions under which colour schemes for a textile print are produced. He saw an

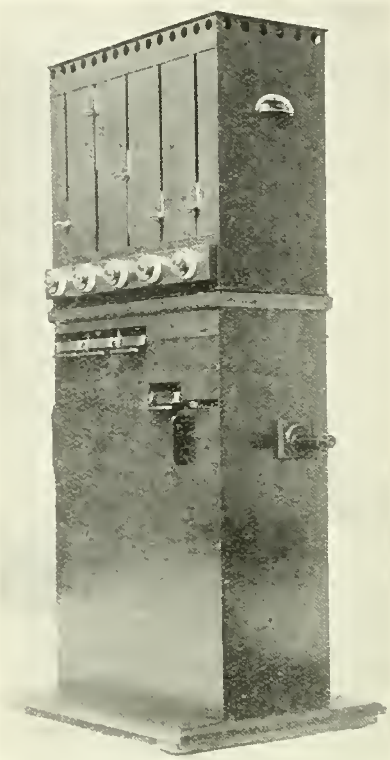

FIG. 3.—THE IMPROVED CHROMOSCOPE.

"army" of artists engaged in making separate paintings for each of countless colour-schemes devised. He saw trial colourings made by painting a trial length of countless separate schemes. The time wasted and fruitless labour set him thinking—to the same problem which intrigued our optician sixty years ago he applied himself—and armed with inventive genius and the fortunate concurrence of Adam Hilger's celluloid mirrors, he made a ten-picture chromoscope, by which a textile printer unaided can observe his pattern in any number of colour combinations.

The weaver, poster-designer, interior-decorator, architect, coach-builder, printer, and potter all range themselves in line with the commercial elders who can call on this invention to simplify their craft and render it more beautiful; and, last in these wide fields, the theatrical producer can summon it to aid him in his colour-encircled scene upon the stage.

Reviews of Books

The Evolution of Climate. By C. E. P. Brooks, M.Sc., F.R.Met.Soc. (Benn Bros., Ltd., 8*s.* 6*d.*)

This book gives an account of the principal changes of climate which have occurred upon the earth, from the earliest remote ages down to and including historic times. It may be a shock to many to learn that there was more than one Great Ice Age; in fact, there were several. "One of the oldest known sedimentary rocks is glacial in origin, and indicated the presence of an ice-sheet at a very early stage in the earth's history. This is a 'tillite' or boulder-clay discovered by Professor Coleman at the base of the Lower Huronian (Early Proterozoic) of Canada. It extends in an east and west direction for 1,000 miles . . ." (p. 32). Another Ice Age occurred just after the Coal Period, when the lost continent of Gondwanaland connected Africa, Asia, and Australia, and when the North Pole was in the Pacific Ocean. Before the onset of the last Ice Age, in which we live, there was a spell of "remarkably mild and equable climatic conditions extending into comparatively high latitudes, so that the west coast of Greenland, for instance, had a flora of almost sub-tropical aspect . . ." (p. 42). It is with the last Ice Age that Mr. Brooks is chiefly concerned. He accepts, with reservations, the orthodox continental theory of several glacial phases, separated by milder periods, and he attempts to give meteorological precision to geological data. He says that the Chellean period "probably" occurred during the second (Mindel-Riss) interglacial period (p. 51), and he is careful at the same time to add in a footnote a warning that this is a subject of recent controversy (it is indeed! and not only in recent times). He regards the Mousterian period as falling in the next (Riss-Wurm) interglacial period (p. 63). He quotes evidence for a rainy period between 1800 B.C. and A.D. 500, reaching its maximum about 400 B.C. The evidence is of many kinds—historical, archæological, and botanical, the latter being the growth-rings of the giant *Sequoias* of America, some of which are 4,000 years old!

For the book as a whole we have nothing but praise. It is a successful attempt to present in a readable form both facts and opinions. It is also a definite contribution to the subject, for Mr. Brooks is a specialist who can also co-ordinate evidence; and he is therefore able to give his own dates to the cycles of changing climate. We miss the maps and some of the letterpress which appeared in his original article in the *Quarterly Journal of the Royal Meteorological Society* (vol. xlvii, 1921, p. 173); but no doubt conditions of space made it necessary to exclude them. It will interest geologists, for there is much geological—or rather palæogeographical—evidence reviewed. This is necessary because Mr. Brooks believes the [last] Ice Age to have been caused by "elevation in high latitudes, and by changes in the land and sea distribution" (p. 23). If the distribution of land and sea can be restored, the temperature can be ascertained. Mr. Brooks shows how, and claims with justice to have added precision thereby to the geographical theory of the Ice Age. (Clearly he would welcome that Atlas of Palæogeography for which we have pleaded, perhaps prematurely, but so far in vain.) It will interest meteorologists for obvious reasons. Indeed, the peculiar value of Mr. Brooks's work is that he attacks old problems from a new quarter; and the history of science shows that that is how they have generally been solved. At the same time his knowledge of geological literature is immense. Archæologists will be interested because the varying influence of climate is of fundamental importance in the evolution of man. Finally, there is nothing in the book that the educated "outsider" cannot understand, provided only that he has some notions of geological time.

But the book must be read critically. The author sometimes states as facts what are really only someone else's theories. That is partly, no doubt, due to a necessarily condensed style, and it is partly the fault of theorists, who do not draw a clear dividing-line between their theories and their statements of generally accepted facts. For instance, on p. 125 he assumes a cultural break between the Maglemose and shell-mound cultures of Denmark, both Early Neolithic; but there is no evidence for this, and Danish archæologists believe that the one evolved from the other. The facts are quite irrelevant to Mr. Brooks's main thesis, and had better have been omitted, but they illustrate the dangers that beset the path of him who travels widely over the field of knowledge. The obvious safeguard is, of course, not to stay at home, but to carry a revolver. The highwaymen of science must be made in this drastic way to produce their evidence or pay the penalty. In archæological circles, as in war, it is a safe rule to shoot first and to take no one's word for anything. It is unfortunate that this should be so, but facts are stubborn and are ignored at risk.

We are very sceptical about Mr. Brooks's attribution of the Chellean to the Mindel-Riss. As regards the Mousterian, recent discoveries in Switzerland seem to prove that M. Boule's correlation is correct and that of Penk incorrect. (A summary of the latest evidence is given in the current number of the *Wiener Prähistorische Zeitschrift.*) Pumpelly's absolute chronology for Anau has been severely criticised and he greatly antedates his cultures. Minor grammatical errors occur on pp. 26 (line 2) and 145 (line 4), and a misprint on the second line from the bottom of p. 73. The arrangement and bibliographies are excellent, and we hope the book will be widely read both by specialists and the general public.

O. G. S. C.

Remembering and Forgetting. By T. H. Pear, M.A., B.Sc. (Methuen & Co., 7*s.* 6*d.*)

The earlier psychologists, in their investigation of memory, endeavoured to treat it as an isolated faculty of the mind, deliberately excluding all meaning from the

subject-material of their experiments; but the results obtained by this method were not very illumimating in themselves, and only remotely applicable to the remembering and forgetting that takes place in our everyday life. Professor Pear therefore rapidly passes over this earlier work to discuss the phenomenon of memory in relation to the general mental life and economy of the individual. The first half of the book deals with the "image," the elusive form in which a past experience is recalled to consciousness. The author is especially interested in "kinæsthetic" imagery,[1] that is, the recall of the actual sensations arising in muscles, joints, and tendons during the performance of a muscular action or in maintaining a certain pose, and a chapter in the Appendix is devoted to an inquiry into the rôle played by these kinæsthetic sensations in the mental life of certain types of individuals (by no means the most primitive) who habitually employ this mode of imagery.

Professor Pear makes the very interesting suggestion that a predominance of a kinæsthetic or a visual and auditory imagery may perhaps be correlated with those two types of character, the "extrovert" and the "introvert,"[2] who find it so difficult to understand, and so easy to despise, one another. He even suggests that if a language could be devised for the expression of the sensations of kinæsthesis, it might be raised to the level of "those aristocrats of sense, sight and hearing," and possibly bring about a rapprochement between the two types of character.

The problem of memory tends to present itself in modern psychology chiefly as the problem of how we forget, of how we keep our consciousness free of the mass of our past experience and prevent it from being flooded by irrelevent associations when an incident is recalled out of the past.

Professor Pear is not overwhelmingly impressed by the evidence of hypnosis and psycho-analytical investigations into believing that all past impressions are indelibly recorded, and he regards (at least provisionally) a spontaneous fading of insignificant experiences as one of the factors in forgetting. As a second factor in the forgetting of insignificant impressions, the author appears to accept Dr. Rivers's theory of their fusion with the main mass of experience, by which process they lose irrecoverably their original form, although he modifies the theory to admit varying degrees of fusion. On the question of the forgetting of significant experiences the author agrees with the now generally accepted theory of repression, though he makes a very fine distinction in separating out a group of experiences that are "superseded" rather than repressed.

Professor Pear claims foı his book no more than that it "may serve as a guide-book to some of Memory's more interesting facts," and if it does not attempt or attain the comprehensiveness and dry clarity of a psychological Baedeker, it is a great deal more stimulating and readable.

F. A. H.

[1] Professor Pear leaves open the question of whether a movement is recalled by means of an "image," or whether it is to some extent reproduced by minimal contractions of the muscles originally employed, but for convenience of description he refers to the process of recall as one of "imagery."

[2] Roughly, the "extrovert" tends to find his expression in action; the "introvert" in thought. (Hotspur and Hamlet are extreme examples.)

Glands in Health and Disease. By DR. BENJAMIN HARROW. (George Routledge & Sons, Ltd., 8*s.* 6*d.*)

Among the many volumes of very different value which have been produced on a subject which has caught the public imagination, this capable little work deserves special mention. It is eminently well suited to give the man in the street a trustworthy appreciation of the importance of "glands" in the medical horizon, without the sensationalism which is too often associated with them. Especially to be commended is the space which is given to a consideration of that by no means negligible school of thought which believes that the importance of "glands" is grossly over-emphasised. For instance, no substance said to be manufactured by these organs and cast into the bloodstream is more generally accepted than "adrenaline" —which is supposed to be formed by glands near the kidney. In fact, adrenaline has been artificially prepared, and its value to the surgeon cannot be disputed. However, Gley, a well-known French physiologist, while not disputing that "adrenaline" can be prepared from these organs, and that when prepared it is a powerful drug, denies that it is ever present in the blood in such proportions as to produce any effect whatever. On the other hand, the American worker, Cannon, has interpreted the behaviouı of animals and men in terms of the activity of this gland—the cat's attitude of terror when a dog barks, the dilated pupils of a frightened child, and the quickened heart-beat of the examination candidate, alike arise from that source. Dr. Harrow holds the scales of justice very impartially between these two schools.

There is a short final chapter on the possibility of the existence of substances having an importance to plant life similar to that which the "hormones" which glands manufacture have to animals. For example, it is said to be bad for fruit-trees to grow them in a grassy meadow, on account of some poison arising from the presence of the grass. We would like further information on this point; though we are aware of the important work of Professor Bottomley, of London, on similar questions. The orchards of Devon and Normandy have borne crops of world-fame for generations, in spite of their grassy carpets, and a comparison of orchard crops as opposed to kitchen-garden crops—where the trees grow in naked soil—does not always flatter the kitchen-garden.

We congratulate the author on the care he has taken to explain "hard words." His vaulting ambition has, however, o'erleaped itself in his explanation of the word "thyroidectomy"—"'dectomy' is derived from a Greek word meaning excision." Few scientific words have much classical erudition to commend them, but "dectomy" is a word that never was on land or sea, or even in the Greek dictionary!

R. J. V. P.

SOME BOOKS ON PSYCHO-ANALYSIS

Studies in Psycho-analysis. By PROFESSOR C. BAUDOIN. Translated by E. and C. Paul. (Allen & Unwin, 12*s.* 6*d.*)

Conditions of Nervous Anxiety. By DR. W. STEKEL. (Kegan Paul, 25*s.*)

The Omnipotent Self. By PAUL BOUSFIELD, M.R.C.S., L.R.C.P. (Kegan Paul, 5*s.*)

The Psychology of Self-consciousness. By JULIA TURNER, B.A. (Kegan Paul, 6*s.* 6*d.*)

Professor Freud's theories have undergone a considerable development since they were first propounded by him some eighteen years ago, and in particular some of the earlier conceptions were found to be a little too narrow as more psychological material was brought under survey, and they were accordingly modified or expanded. But there are a number of psychologists who feel that the Freudian theories, even as they stand to-day, are, in some respects, too limited and rigid, holding good in many cases but not universally applicable.

Professor Baudoin, writing with great moderation, and supporting his views with an accumulation of evidence from his practice, suggests that an expansion of certain of Freud's theories would make them more widely applicable. He suggests, for example, that Freud's formula, that the dream is a manifestation of a repressed wish, may be broadened into " the dream manifests the (symbolical) realisation of an unsatisfied tendency." It is, however, in practice rather than theory that Professor Baudoin departs most widely from the Freudian school, since he advocates the use of auto-suggestion as an accessory to psycho-analysis in the treatment of nervous disorders.

One of the chief difficulties in the use of psycho-analysis as a method of treatment lies in the length of the process, and every practitioner of the method is on the alert to discover a means of shortening it. Freud himself is not, apparently, intolerant of the combination of other methods with his own, but his followers are often *plus royaliste que le roi* in their insistence upon a purity of technique. The method of auto-suggestion is at least free from many of the disadvantages (such as dependence upon the operator, etc.) that attach to hypnotism and to direct suggestion by the physician, and in Professor Baudoin's hands it seems to have produced valuable results in helping the patient towards a new attitude after an understanding of his trouble has been secured by analysis.

Freud, in the pioneer work of psycho-analysis, divided the instincts into two groups, the sexual and the self-protective (the *ichtriebe*) and, for certain good reasons, devoted himself chiefly to the study of the former. Professor Baudoin urges that more clinical application should be made of the work that has been done upon the separate self-protective instincts as by Adler, Ribot, and the late Dr. Rivers, and he reminds us that the sexual instinct is not the only one that is liable to be repressed by the conditions of modern civilisation. His book is written principally for the practitioner, for whom it should prove a very valuable addition to the fundamental textbooks.

Dr. Stekel joins issue with Freud upon a purely technical question, that of the causation of the " anxiety neurosis." Dr. Stekel holds, very emphatically, that a psychological factor is the principal cause, and that it is not due, as Freud states, to relative sexual deprivation. But cases of anxiety in which no psychological factor is discoverable are comparatively rare, and become rarer the more closely they are investigated, as even the most orthodox of Freud's followers admit, so that Dr. Stekel's heresy is not a very important one.

Dr. Stekel does good service in pointing out that many cases of anxiety neurosis resemble, and are liable to be mistaken for, organic disorders of the heart, stomach, etc. ; but unfortunately his book is not distinguished by any great clarity of thought or close reasoning. He gives, for example, three definitions of " anxiety " that are not easily reconcilable (pp. 4 and 24), and on p. 37 summarises one of his cases (in apparent contradiction to his theory) as " a case of anxiety resulting from sexual abstinence." Dr. Stekel writes for the medical profession, and intends his book to be " an introduction to psychotherapy," a purpose for which it appears to be far too specialised and one-sided.

Dr. Bousfield points out, in the introduction to a small book on *The Omnipotent Self*, that many undesirable character traits, such as self-importance, irritability, over-sensitiveness, etc., have been found amenable to psychological treatment ; in the book itself he takes for his theme " Narcissism " (which is roughly self-love) as being the commonest and most powerful cause of these faults of character, and he traces its development from largely avoidable factors in the child's education and environment. Apart from certain slightly dogmatic expressions of personal opinion, Dr. Bousfield follows the main lines of the Freudian theories, and it is presumably for the sake of simplicity that he gives no indication that the views he puts forward are not universally accepted.

In *The Psychology of Self-consciousness* Miss Turner sees the whole mental life of the normal individual in terms of a conflict between the will to power and the tendency to " expiation." The explanation given of the universal validity of this theory is not very easy to follow, especially as very little evidence is brought forward to support it, but, so far as we can understand it, the conflict here described does not seem to differ from certain aspects of the particular conflict between the sexual impulse and the ego impulses that are fully dealt with in the standard works on psycho-analysis.

F. A. H.

Fundamentals of Biochemistry in Relation to Human Physiology. By T. R. PARSONS. (Heffer, 10*s.* 6*d.* net.)

The science of that aspect of chemical change which is peculiarly associated with life is daily assuming greater importance. With so young a branch of knowledge it is inevitable that the subject has to a great extent to be studied in original papers, not always accessible—and too frequently rather unintelligible—to the learner. The author—who writes from Cambridge, one of the chief homes of the science in England—has written

a book which supplies a very definite need. Medical students will find this book admirable for their purposes, and the references to fuller expositions of the questions dealt with will be of considerable assistance to those more advanced in a science from which a great deal is to be hoped for in the years to come.

Heredity in Poultry. By REGINALD CRUNDALL PUNNETT, F.R.S. (Macmillan & Co., Ltd., 1923, 10s.)

The importance of Mendel's work on heredity and his discovery of the simple laws governing the transmission of inherited characteristics in certain plant forms has perhaps not been sufficiently appreciated by the world at large. Professor Punnett was one of the first to realise the potentialities of these investigations, and by his untiring work over a number of years has proved conclusively that the same general laws govern heredity in animal life. Working with poultry, by selective breeding and careful observation, he has shown that such characters as plumage, colour, broodiness, and egg-production (to mention but a few) are inherited strictly on Mendelian lines. It would seem at first sight that research of this type were largely of academic interest; but we are shown by the author how the economic value of these researches is already recognised by poultry breeders. Breeding hitherto has been purely empirical. With a knowledge of these laws it is now possible to ensure the preservation of breeds of maximum fecundity; and there is great promise that in time the disheartening results of empirical breeding will be altogether avoided.

Professor Punnett confines himself modestly to the practical and economic value of his work to the poultry industry. May we point out that the laws governing vegetable and animal life are also those that apply to our own, the Human Species? So many of the diseases and handicaps of the individual man depend obviously on inherited constitution; and we should like to look upon this research as part of a field of large scope—the study of the laws which govern the preservation of the healthiest and most stable qualities of Human Body and Mind.

A. C. MOWLE.

The Evolution and Progress of Mankind. By PROFESSOR HERMANN KLAATSCH, M.D. Edited and enlarged by PROFESSOR ADOLF HEILBRON, M.D. Translated by JOSEPH MCCABE. (T. Fisher Unwin, Ltd., 25s. net.)

It must be obvious to all those who venture into the fascinating labyrinths of anthropology that it suffers in one extreme of its investigations from too much information, and at the other extreme from too little. Of very ancient man we know all but nothing; whereas with regard to modern man, each race, if not each individual, presents its separate quota of matter for surmise and classification.

Yet the trite quotation "The greatest study of mankind is man" remains apt; and curiosity as to how man, "in form how like an angel, in imagination how like a god," achieved his eminence will always seek to be satisfied. And here is a book which will go some way, at least, in doing so. "The Evolution and Progress of Mankind" would be a gigantic subject even for Mr. H. G. Wells, and obviously the three hundred odd pages of this book have not included all that may be said on the subject. In point of fact, the book may be divided into three sections—a consideration of the anthropoid apes, a most interesting account of the Australian aborigine, and a critical discussion of the all too short series of primitive skulls. In addition, there are paragraphs here and there filled with those curious anecdotes and descriptions of primitive habits which anthropologists know well how to produce.

The reader is soon taught to walk warily in anthropology. Consider that first exciting find—the fragments of a skeleton at Neanderthal in 1856. Virchow, the great German pathologist, thought that they were the remains of a fairly recent man who suffered from rickets and gout. Huxley, for England, said it was of great age; Professor Mayer, from out the German ranks, retorted that the bones were those of a "Mongolian Cossack of Chernichoff's army corps of the year 1814."

The eminent writer of this work, in common with practically all anthropologists of to-day, emphatically believed that the bones were exceedingly ancient. This belief is founded on the discovery of a series of skulls showing peculiarities similar to those of the Neanderthal celebrity. The argument, implicit rather than expressed in this book, is that one peculiarly eccentric skull might be explained by its being a sport or a pathological specimen by accident preserved, but that the chance that a series with similar characteristics, all at variance with the norm of their fellows, should be preserved and found is a very small one. Add to this that in the main these skulls were found in geological strata of ascertainable age, although, of course, burial, if one is only buried deep enough, might bring one to any geological age whatever.

There is only one small point. The preservation of a series of abnormal skulls would equally be explained if by virtue of their abnormality they were specially protected against the disintegrating effects of time. Rickets is a disease which affects bones, produces bulging frontal eminences, and bends the thigh-bones in a curve. After cure—for it is a childish ailment—the bones remain abnormally dense, and so more likely to survive the ages. "Paget's disease" is another producing similar changes as regards the bulging forehead, but here the bones get less dense. Virchow, as we have said, thought that the Neanderthal man was rachitic—an old sufferer from rickets; and although he is now contradicted, it is uncomfortably true that Virchow's opinions on any subject were uncommonly reliable. There are some who, perhaps, would only be absolutely convinced on the subject of the appearance of ancient man by the discovery of a whole graveyard of consistent skeletons. Perhaps even then they would require to be convinced that there was not once a prehistoric hospital for cripples near-by! In all, it may be mentioned, eighteen skulls of supposedly great antiquity are discussed in this book, and this small number serves

to indicate the lamentably small space in which scientific surmise may disport itself.

To sum up the author's theories, it may be said that he believed that at least two races of ancient man could be differentiated—Aurignac man and Neanderthal man. The former came from Asia, and was distantly related to the orang-outang; the latter from Africa, and was a cousin of the gorilla. Perhaps other races were similarly related to the chimpanzee and gibbon.

For the rest, his outline of man's advance, his descriptions of Australian customs, and his *obiter dicta* deserve more space than can here be allotted to them. He thought that the wearing of clothes was ruining the human figure, evolved by long ages of æsthetic selection, now mainly impossible; he thought that man retained his power to vary, paradoxically, by remaining primitive—to grow hoofs, like a horse, is to commit yourself to a line of your own, whereas to retain the primitive hand, like the newt and man, is to retain the potentiality (precious word!) of development. The reader will learn why dingo dogs do not bark, and what the gibbon's attitude toward life is: he will read of a suggestion as to the primitive language of man, and will appreciate, we believe, that the author was not only a very learned, but a most human individual in his affection both for animals and for man savage and civilised. The book is admirably printed, as an example of the difficult art of translation it is thoroughly to be commended, and not the least part of its attractiveness arises from its many excellent illustrations. In conclusion, Professor Klaatsch's own words should be quoted: "The man who would form his own judgment on these matters will find it necessary to make a thorough study of the skeletons of man and the anthropoid apes. It is no use just making sceptical remarks on the subject."

R. J. V. P.

Books Received

(Mention in this column does not preclude a review.)

ARCHÆOLOGY AND ANTHROPOLOGY

A History of Magic and Experimental Science. By PROF. L. THORNDIKE, Ph.D. In two volumes. (New York: The Macmillan Company.)

The Evolution and Progress of Mankind. By PROF. HERMANN KLAATSCH, M.D. Edited and enlarged by ADOLF HEILBRON, M.D. Translated by JOSEPH MCCABE. (T. Fisher Unwin, 25*s.* net.)

PHILOLOGY

The Study of English Speech by New Methods of Phonetic Investigation. By E. W. SCRIPTURE, Ph.D. (Published for the British Academy by Humphrey Milford, Oxford University Press, 3*s.* 6*d.*)

PSYCHOLOGY AND PHILOSOPHY

Macrobius, or Philosophy, Science, and Letters in the Year 400. By THOMAS WHITTAKER. (Cambridge University Press, 6*s.* 6*d.*)

The Meaning of Meaning. By C. K. OGDEN, M.A., and J. A. RICHARDS, M.A. (Kegan Paul, 2*s.* 6*d.*)

The Appearance of Mind. By JAMES CLARK MCKERROW, M.B. (Longmans, Green & Co., 6*s.*)

Psycho-analysis and Suggestion Therapy. By DR. WILHELM STEKEL. (Kegan Paul, 6*s.* 6*d.*)

ECONOMICS

Food Production in War. By THOMAS HUDSON MIDDLETON, K.B.E., C.B., LL.D., Deputy Director-General, Food Production Department. (Oxford: at the Clarendon Press, 10*s.* 6*d.* net.)

SCIENCE

The Spectroscope: and its Uses in General Analytical Chemistry. By T. THORNE BAKER, A.M.I.E.E., F.R.P.S. Second Edition. (Baillière, Tindall & Cox, 7*s.* 6*d.*)

Il metodo sperimentale secondo Leonardo da Vinci, e sua applicazioni alla teoria cinetica dei gas. (Roma: Casa Edit: "L'elettricista.")

Relativity. By NORMAN ROBERT CAMPBELL, Sc.D. (Cambridge University Press, 7*s.* 6*d.*)

Scientific Thought. A Philosophical Analysis of Some of its Fundamental Concepts in the Light of Recent Physical Developments. By C. D. BROAD, M.A., Litt.D. (Kegan Paul, Trench, Trübner & Co., 16*s.*)

An Introduction to the Principles of Mechanics. By J. F. S. Ross, M.C., B.Sc., A.M.I.Mech.E. (Jonathan Cape, 12*s.* 6*d.*)

General Science. Part I. By GEORGE THOMPSON and GEORGE H. LESLIE. (Cassell & Co., Ltd., 2*s.*)

Colour and Methods of Colour Reproduction. By L. C. MARTIN, D.I.C., D.Sc. With chapters by WILLIAM GAMBLE, F.R.P.S. (Blackie & Son, Ltd., 12*s.* 6*d.*)

The Generation and Utilisation of Cold. A General Discussion held by the Faraday Society. 10*s.* 6*d.*

Correspondence

AXIAL ROTATION

To the Editor of DISCOVERY

SIR,

Will you be good enough to deal with the above subject in DISCOVERY?

I am prompted to ask this question by the extreme perplexity I always feel when I meet with the statement that the "moon rotates upon its axis." Always in this connection synchronisation of rotation and revolution is specially mentioned as being something remarkable. The same is the case when dealing with the planets

Mercury and Venus. As regards this coincidence it seems to me it could not be otherwise whether the time taken by the moon be twenty-eight days or 28,000,000 years. This change of speed would still leave the same face of the moon turned towards us.

If I have, say, a cricket ball suspended on the end of a few yards of string and swing that round in a circle above my head, is there anything strange in the fact that the same face of the ball is always turned inwards?

Surely the strangest assertion would be that the ball was turning upon its axis. Rotation has been defined as "lines in a rigid body changing their direction." If the moon could henceforth be made to turn upon its axis in a reverse direction to its revolution, and in the same time lines in it would not change their direction. But we have now introduced axial rotation surely, because lunar inhabitants (if any) would see the earth rising and setting. If we introduce a new rotation in the same direction as revolution, we shall get this rising and setting of the earth. But what a difference this new rotation from the old! Now, as in the case of sun spots proving the rotation of the sun, we shall have moon markings proving the rotation of the moon. According to the definition, the pedal of a push bicycle when ridden does not rotate upon the pin. Take the familiar railway turntable. It rotates upon its axis. Place a cricket ball exactly in the centre, when the table turns the ball will rotate upon its own axis; place an orange resting near the circumference. Is that rotating upon its *own* axis when the table is turning? If so, what is a spinning-top doing in a similar position when the table is turning? The earth has, of course, axial rotation in addition to revolution, and we get rising and setting of the sun, but it has also (if the moon has) axial rotation because of revolution in its orbit. To call each of these "axial rotation" without qualification is rather perplexing. In the case of the planet Uranus I read that its axis almost coincides with the plane of its orbit. In this case I suppose we get one axial rotation because of revolution and axial rotation pure and simple.

If everything carried round in any particular path, circular, elliptical, or otherwise, is turning upon its axis, then every pebble on every beach upon the surface of the earth is turning upon its own axis. If the moon could be brought near enough to the earth to rest upon it, the same face would, of course, always be turned towards it, but like the other pebbles, it would of course be turning upon its axis, according to the definition, but in about twenty-four hours, instead of about twenty-eight days; but there is now nothing extraordinary in time of axial rotation coinciding with revolution. Distance is, I think, the only change imagined here, apart from time of revolution.

As a familiar illustration take the face of your watch. The minute and hour hands rotate on an axis, and the seconds hand on another. On the heel of the seconds hand is a disk. Let this represent the moon, the axis of rotation the earth, and the axis of rotation in the centre of the watch the sun. Can the disk (or moon) attached rotate on its axis?

Imagine the disk detached but still revolving. Even then it is not rotating upon its axis.

Of course I can see that the moon, in a journey of about 1,500,000 miles, turns itself round, but surely this cannot be axial rotation. When the moon really rotated, was not the earth rising and setting? and when this rising and setting ceased, did not axial rotation also cease?

As an unscientific reader I shall be glad if you will deal with the points I have raised, especially the everyday illustrations.

I am, Sir,

Yours, etc.,

J. Marshall.

2 Heath Villa,
Birchwood Drive,
Leigh-on-Sea.

February 14, 1923.

To the Editor of Discovery

Dear Sir,

Even Homer sometimes nods, and the Editor of so excellent a magazine as Discovery may be excused for doing the same. But surely there is a slip in the last of the Editorial Notes in the March number (p. 59). There, in connection with the discovery of the new element Hafnium, it is said: "The use of kathode rays, as they are called—the bombardment of a crystal by electrons from an X-ray tube—produces an equally characteristic spectrum on a sensitive photographic plate." This sentence seems to contain several inaccuracies. An X-ray tube emits X-rays, and not electrons. The kathode rays or electrons bombard the antikathode *within* the tube, and the antikathode then becomes the source of X-rays. The crystal in the X-ray spectrometer is "bombarded" (if that term is appropriate) by the characteristic X-rays of the element under examination, and by reflecting these from successive planes of atoms within itself acts as a diffraction grating for these rays, and so produces their spectrum. The characteristic X-rays of an element may be produced either by having the element in question on the antikathode (the direct method), or by exposing it to ordinary (mixed) X-rays which are "harder" than the characteristic X-rays of the element. In place of the element, of course, a suitable compound may be used. Moseley used the direct method of generating characteristic X-rays (Kaye, *X-rays*, p. 200). What method may have been employed by Coster and Hevesy I do not know.

Yours, etc.,

James Patrick.

United Free Church Manse,
Ballater,
Aberdeenshire.

February 28, 1923.

[The Editor is grateful and regretful.—Ed.]

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Editorial Notes

"After many summers dies the swan," sighed Tithonus, weary of immortality. The heroes of old myths, from the Wandering Jew down—shall we say?—to Ayesha, She-who-must-be-obeyed, found relief from humanity's last duty, that of dying, a gift of the Danaids, a fatal gift. Doubtless the myth of the lover of the dawn, growing eternally old, expresses that divine human power of acquiescence in the inevitable and of appreciating its excellences which makes cruel men whisper "Sour grapes." Man alone, say philosophers, has foreknowledge of death, though the big-game hunter believes in an intuition of mortality which makes the elephants foregather in lonely places when their hour has struck. But in fact it would seem that, though we all admit ourselves mortal, we are really gloriously incredulous about it. Nothing overwhelms our hearts with such devastating gloom as a scientist's prophecy that this world of ours has only another million years to last. Motor accidents we may laugh at; the ills which the flesh is heir to we may forget; but to hear that, inevitably, in one million years we will be frozen stiff or burnt out, as our authority of the moment teaches, is appalling news. No man can love his infinitely unborn grandchildren so much as to let their fate sadden him. We do not shudder at the tragic chillness of our forebears when the Ice Age came upon them. It is ourselves we would weep for, when we read, as in H. G. Wells's wonderful book *The Time Machine*, of a picture of the last living creature, all but lifeless in the frozen tropics.

* * * * *

This distaste of wholesale extinction, remote or imminent, has often received national and even world-wide expression. In the year 1000, it is said, pilgrims travelled like a devastating army to Jerusalem, there to await the inevitable end of the world. "A thunderstorm sent them all upon their knees in mid-march." Many times the return of comets has been the occasion for prophecies of universal extinction. In the year 1524, on the 1st of February, according to the astrologers, the Thames was to rise and wash away ten thousand London houses. The prior of St. Bartholomew's built a species of Noah's Ark to save himself and his household. Yet "Sweete Themmes ranne softly" that fatal day, as any other. Our astrologers—forgetful of the signs of the Zodiac, yet true to their traditional task of foretelling destruction—concentrate to-day on the eventual extinction of our sun. It is a commonplace that from it we draw all our means of existence, to it we owe our life. If we exclude some dislocation of celestial traffic, and a collision of our planet in mid-space, when we should all become extinct in the momentary glory of a new star, it is to the sun that we must turn our anxious eyes, when we are struck with the fear of a threat to our immortality. Of course, now and again other difficulties, due in a sense to our insufficient use of the sun, confront us. Professor A. H. Gibson, in his little book *Natural Sources of Energy*, has discussed some of them. The world's coal supplies, for example, may not last more than 350 years. The whole world's oil supply will last us 500 years; and the only other important source of stored-up energy, radium, will scarcely help us on our Tithonus-search of immortality. When we are approaching our five-hundredth year, doubtless we will turn our minds to the use of wind power, water power, tidal power, and direct sun energy to work our world. If, in point of fact, we ever do solve the problem of greatly prolonging the average life of man,

the Malthus problem of reproduction and food-supply production will become acute ; although, as Dean Inge points out, it is the supply of food-stuff and the wherewithal to live that really limits the population of the world.

* * * * *

While our sun lasts, the using up of the earth's energy stores, while producing tremendous changes in the distribution of the world's population, will not gravely threaten man's existence, even in great numbers. While the winds blow and the waterfalls last there will always be great possibilities of energy production. And when the cooling sun tempers the vigour of the storms, and by the diminution of evaporation dries the water-courses, the tides can still be harnessed, and used, as they once were near Newhaven, in Sussex, for mechanical power. When we are well on in our hundred thousands, though still in the prime of our immortality, the seas will all freeze over—and where shall we then go for our sources of energy ? There will be no further store inexhausted ; forests and coal-fields, oil-wells and peat supplies will be long-forgotten luxuries. Perhaps we shall have learnt by then how to use the energy of the atom—how to chain the force of gravitation. Perhaps we shall be independent of the sun. At least we may hope so ; is not necessity the mother of invention ?

* * * * *

Meanwhile, what keeps our sun hot ? Perhaps most people think of the sun, in a dim kind of way, as a gigantic bonfire, which will in time turn into a vast celestial ash heap. That is, however, certainly not true, because the highest known temperature of combustion is about 3,000 degrees, and the sun has a temperature of 6,000 degrees ; and, moreover, it has been calculated that no bonfire could give more than 2,500 years of heat. The number of years during which the sun has been radiating heat energy is a difficult problem to solve ; but estimates are usually expressed in hundreds of millions. Alex. Véronnet, astronomer at the University of Strasburg, who discusses the problem in the *Revue Générale des Sciences* (March 30, 1923), considers most estimates, which are based on such facts as the formation of rocks and the increasing saltness of the sea, to be too large. They assume that things took as long to happen millions of years ago as they do now ; whereas, with a hotter sun the solution of substances in rivers, which causes the saltness of the sea, must have been a more rapid and complete process. Still, our earth and our sun have a long and distinguished history, and an explanation of the sun's heat must satisfactorily take into account these tremendous ages. Other theories have been suggested. Robert Mayer considered that the sun was fed by showers of meteorites. But this would involve an increase in the mass of the sun, and therefore an acceleration of the earth in its orbit and a shortened year. Even if meteorites within the orbit of the earth were to feed the sun, the alteration in the orbit of Mercury would be perceptible. There are many reasons, also, which render a theory of radio-activity as a source of sun energy inadmissible.

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The theory which Lord Kelvin adopted and which Alex. Véronnet selects as most plausible was originally advanced by Helmholtz. His opinion was that the sun's heat was the result of the energy of its gradual contraction. Those who wish to investigate the basis of this theory cannot do better than refer to Monsieur Véronnet's article. The deduction from this theory is that in 100,000 years the mean temperature of this earth will be five degrees lower. In a million years, the temperature will be below zero, and the whole earth will be frozen over. Imagination dare not picture what the life of man, in that eternal arctic winter, will be. The change will have come so gradually that men will be reconciled to it. But it is a dismal picture. As one sits by a coal fire in winter, or lazes in the summer sun in these halcyon days of the sun's gracious middle age, perhaps we ought to be grateful that we have been born in what is probably the most bountiful and luxurious age the earth has known or ever will know. And we may think again before we regret that we may not hope to see the end of the story.

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There is, however, another theory of the sun's heat which Monsieur Véronnet does not accept, but which English authorities prefer. They do not believe that the contraction theory accounts for more than a five-hundredth part of the energy of the sun. The alternative theory is based on the supposition that elements are formed from hydrogen. If that is so, the mass of their atoms ought all to be exact multiples of the mass of the hydrogen atom. In point of fact, their masses are in general a little less than the calculated figure. The discovery of isotopes by Aston, accounts, in a sense, for this discrepancy ; but it is also possible, using the arguments which Einstein first brought forward, to explain the sun's energy by assuming that the extra mass has been turned into radiant energy. And such a theory postulates a far older sun, and a much greater lease of life on its present scale, than the contraction theory of Helmholtz.

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We have received the following bulletin among the admirable series which Harvard College Observatory circulates :

HARVARD COLLEGE OBSERVATORY

Bulletin 785

"*Results from Australian Eclipse.*—A night letter received at the Harvard College Observatory April 12 from Professor W. W. Campbell, Director of the Lick Observatory, states that three pairs of the Australia-Tahiti eclipse plates, measured by Campbell and Trumpler, with sixty-two to eighty-four stars on each plate, and with five of the six measurements completely calculated, give values between 1".59 and 1".86 for the Einstein deflection. The mean observed value of the deflection is 1".74.

"The value predicted by Einstein, for the deflection of stars at the limb of the Sun, is 1".74.

"Harlow Shapley."

Cambridge, Massachusetts.
April 13, 1923.

Every congratulation is due to the skilled observers who have obtained such a satisfactory result. The British expedition met with ill-fortune on their attempt to verify Einstein's predictions, since cloudy weather, as is described in *Science Progress* for April 1923, interfered with their plans. It appears, however, that we may have to modify our attitude towards these terribly involved questions of the nature of light and gravitation. At present it is too early to form a definite opinion, but it is at least possible that the fact that Einstein was proved so completely right shows him to have been in some respects wrong! In the main, his theories hold the field, but the work of Professor Eddington, of Cambridge University, has led to some radical alterations in his original attitude.

* * * * *

It is a familiar fact, and not altogether a surprising one, that it is possible to grow several generations of bacteria and other minute primitive forms of life on artificial foods—meat extracts, sugar, and jellies. The actual essentials of diet for these creatures are, however, very few in number, and in many cases life has been sustained without the aid of any food-stuffs so complicated as those we have mentioned—by the use of a few selected inorganic salts, and simple nitrogen compounds. It is less generally known, however, that for some years the actual cells which form the bodies of animals have been grown, in a very similar manner, for many generations, separated from the body in which they once grew. To those who are not familiar with the mysteries of the growth of the structural elements of our bodies, perhaps the most striking element in these tissue-cultures is the fact that some tiny fragments of the body can in this way continue living, almost indefinitely as far as can be seen, while the whole, of which they once formed a part, has long been dead. We know that primitive creatures, whose reproduction takes the form of a simple division into two parts, seem to have the gift of immortality—each is as old as its neighbour; each is new-born with the birth of its progeny. The reproductive cells of higher animals, the "gonads," which on uniting develop into the mature form, show this same property of immortality. But, since by careful attention it has proved possible to grow glands, nerves, and heart fragments for indefinite periods, it would seem that this immortality is the property of all living matter, and we return to the theories of those who have believed that death was an accident, and immortality within our grasp. It must be admitted that up to the present we can only persist as minute isolated fragments—a privilege little happier than that which the inhabitants of Central Asia believe their relations, who have been eaten by vultures, and thus become living matter again, to enjoy.

* * * * *

Dr. A. H. Drew, D.Sc., of the Imperial Cancer Research Fund, has described the technique of this exciting research, and some of its more suggestive results, in the *Lancet* of April 28, 1923. Those who have had an opportunity of seeing, through a microscope, a minute part of a heart, beating vigorously without any blood to circulate, or a number of cells from the cartilage of a joint, dividing up before our eyes, "foaming" and putting out little tentacles, will be convinced that the study of these marvellous happenings cannot fail to be of immense importance to many branches of medicine. For years fierce battles were fought over the question of the origin of the heart-beat—was it controlled by nerves, or did it beat of its own accord? Tissue-culture proves that the heart certainly beats of its own accord, however much nerve control may vary its beat. Again, "fatty degeneration" of the cells of the body is a morbid condition familiar to pathologists, but very obscure in its nature. It has been imitated in tissue-culture. Perhaps, however, the most important results have been obtained in connection with the study of cancer cells. It has been found that they contain, ready made, growth-stimulating substances which other cells only provide when they are broken up. A tissue-culture whose growth is slow may be speeded up by the addition either of broken-up ordinary cells, or by living cancer cells. This fact seems to us among the most significant discoveries which have been made up to the present in this connection. We have frequently drawn attention in these notes to the great importance to humanity of any new fact which can be produced in relation to the terrible plague of cancer. Tissue-culture, we are convinced, offers unique opportunities for the investigation of the problem, and we look forward with great interest to the further researches of Dr. Drew, and of other

workers, who are pursuing similar studies at the Research Hospital in Cambridge.

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Professor A. Mawer's article on "Place-names" in a recent number of this journal proved of great interest to many of our readers. One of the advantages of living in an island rich in history—of invasions, peaceful or the reverse, and of slow but peculiarly characteristic development—is that in the names of our country villages, and even in ourselves, we carry the material for the most thrilling researches. We are, as other nations rudely tell us, a mongrel race. What nation that has ever achieved greatness was otherwise? Our churches, Saxon, Norman, and Gothic, down to the nondescript tabernacles of to-day, tell their story to any week-end walker in the countryside. Names, however, are a more subtle problem; yet, as Professor Mawer pointed out, the story they tell is none the less clear and illuminating to the initiate. The English Place-name Society, with which not only Professor Mawer, but also Mr. O. G. S. Crawford, a frequent contributor to DISCOVERY, are intimately associated, has been formed to make a comprehensive survey of the rich mine of material which our land provides. The counties of Berkshire, Buckinghamshire, Essex, and Lincolnshire will be among the first to be surveyed, and the results are to be presented in forthcoming publications of the society. We feel sure that many of our readers will be glad to get into touch with this most interesting study, and full details will be given on application to the Hon. Secretary, The University, Liverpool.

Six Great Scientists. By MARGARET AVERY. (Methuen & Co., Ltd., *2s. 6d.*)

We hear so little of the private lives of great scientists that we are inclined, sometimes, to think that they have none, that they live in a plane very different from our own, wherein test-tubes and mighty discoveries take the place of our little romances and everyday adventures. But in this book we read of many very human incidents which seem to bring us in much closer relationship to men who have revolutionised the thought and the practice of recent years. Pasteur, Lister, Darwin, Wallace, Mendel, and Galton are portrayed for us: we hear of Darwin's perpetual ill-health and brave endeavour in despite of it; of Lister and his unfortunate lapse at school, which forced his parents to withhold a "plumb cake"; of Pasteur's fervent patriotism and great kindliness. The main features of the life-work of these six eminent men are brought out in a most clear and interesting manner. The sex of the author is clearly shown in her very just emphasis on the influence of a well-selected wife on a scientist's work! We recommend this book as an example of interesting and stimulating biography.

Suspended Animation—I

By Sir Arthur E. Shipley, G.B.E., F.R.S.

Master of Christ's College, Cambridge

Tardigrades, Rotifers, and Nematodes

IN an article I wrote some year or two ago, dealing with Life, it was pointed out that Life was difficult, if not impossible, to define, but that living organisms have certain definite attributes such as breathing, feeding, moving, reproducing, and so on. There are, however, times when these functions are suspended.

If we collect some of the debris in gutters, amongst moss, or in holes in trees, or in ditches, and examine it under a microscope, we may be lucky enough to come across one or two specimens of a group of very small animals known as TARDIGRADA. These little creatures are minute, and in some cases transparent. Zoologically they are remotely connected with the great group of spiders, but they have no near relatives. They are provided with four pairs of legs ending in claws, and their slow and deliberate movements have earned them the name of Bear-animalcules. They live obscure and hidden lives, "remote from the world," as Cecil Rhodes described the lives of the Dons at Oxford. Of animals that consist of many cells, they are amongst the smallest, averaging one-third of a millimetre to one millimetre in length. So obscure are they that they are usually overlooked, yet Max Schultze asserts that they are, without doubt, the most widely distributed of all animals that are segmented.

The TARDIGRADA possess many features of interest. Some species look like dear little sucking-pigs in plate armour. In their natural state—in a damp atmosphere—they live, and move, and have their being, like any other animals; but if their surroundings dry up, or if one be removed and placed upon a slide and allowed to dry, then will their movements gradually slacken until they entirely cease. The body begins slowly but steadily to shrink. The outline and form are lost. The skin becomes wrinkled and folded, and in a short time it assumes the appearance of a much-weathered grain of sand, and all vital activities are suspended, or at any rate reduced to an unascertainable minimum. In this dried-up condition tardigrades may remain for many years without undergoing any visible change. If, however, they be moistened with water, the steps the animal underwent when drying up are retraced. The "grain of sand" begins slowly to swell; the wrinkles disappear; gradually a plump little animal—for they are so plump that you feel inclined to pat them, only they are too small—swells up; the legs stretch out; and slowly

the animal assumes its normal shape. For a time it remains quiet, and then it begins slowly and feebly to move about, and after a period which varies from

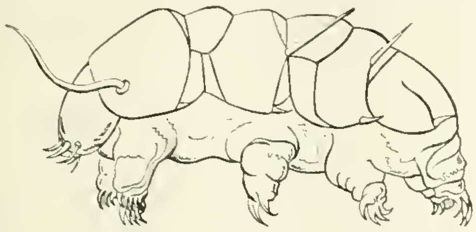

FIG. 1.—A TARDIGRADE.
Highly magnified.
(*From Doyère.*)

a quarter of an hour to several hours, according to the time its life has been suspended, the little animal crawls away " on its lawful occasions."

In the same sort of position, in gutters, amongst moss, are another group of animals known as the ROTIFERA or wheel-animalcules. These are creatures of singular beauty which bear on their heads a number of cilia whose rhythmic flickering produces an appearance of a wheel going round. More than 200 years ago Leeuwenhoek recorded the fact that these little microscopic animals were also capable of drying up, and resuming their normal activities when moisture is again applied. As long ago as 1774–5 Mr. Baker, in a letter addressed to the President of the Royal Society, stated that the animal described " can, however, continue many Months out of Water, and dry as Dust ; in which Condition its Shape is Globular, its Bigness exceeds not a Grain of Sand, and no Signs of Life appear. Notwithstanding, being put into Water, in the Space of Half an Hour a languid Motion begins, the Globule turns itself about, lengthens by slow Degrees, becomes in the Form of a *lively Maggot,* and most commonly in a few Minutes afterwards puts out its Wheels, and swims vigorously through the Water in Search of Food : or else, fixing by its Tail, works them

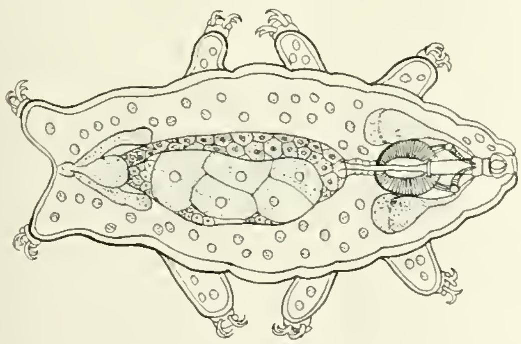

FIG. 2.—A TARDIGRADE, SHOWING INTERNAL ORGANS.

in such a Manner as to bring its Food to it. But sometimes it will remain a long While in the Maggot Form and not shew its Wheels at all."

Still another group of animals very widely distributed are the threadworms or NEMATODES. Some of these live freely in the earth or water, but a great number of them are parasitic or live inside the bodies of other animals or plants. Amongst the parasites of the latter is the threadworm which causes the ear-cockles in corn. These cockles are brown or purple galls or tumours which replace the grain of corn and each of which contains hundreds of minute microscopic thread-worms. Motionless and apparently dead, but not decayed, in these galls the little worm can live in dryness for at least twenty years. But when moistened, and this usually takes place by the gall falling on damp ground, they resume their activities, making their way to the young wheat plants and, wriggling up the leaves and stems, find their way again to the ear. Here they pair and lay numerous eggs from which the threadworms of the ear-cockle arise.

Snails and Slugs

It should be noted that, whereas in the case of the rotifers or the tardigrades the animal shrivels and loses its outline, this is not the case with the thread-

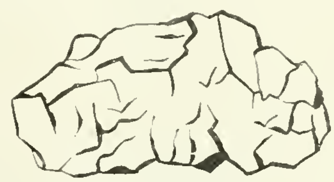

FIG. 3.—A TARDIGRADE, DRIED, IN A STATE OF APPARENT DEATH.

worm, and the suspended animation is prolonged and not seasonal. But many other animals in the temperate zones go into retreat during the winter, whilst in warmer climates they hide away during the hotter months of the year, or perhaps one had better say during the dry season. For instance, many snails hibernate during the winter. Most land-snails, as the first frost nips the vegetation, retreat under stones or into cracks or crannies in walls in tree trunks. Others bury themselves deep in the earth or under moss and leaves. Many common snails are often found living together in clusters, in some sheltered retreat, or, rather, not so much living as surviving. On the other hand, slugs usually hibernate alone. They excavate a nest in the earth, contract until they become almost spherical, and lie in their retreat in a hardened slime. The snails close their shells by the secretion of a membrane or chalky valve, and both snails and slugs take care to be in good condition before beginning their winter sleep. And for this reason our Allies who eat snails usually prefer those taken during the autumn. During this hibernation their breathing and circulation are reduced to a minimum and during the winter they lose weight.

Insects

Amongst insects, the adult forms occasionally hibernate, for instance the common house-fly. The great majority of house-flies die down in the autumn, but a few manage to live over the winter in retired crannies, especially in chinks in the timbers of warm stables, or hidden away in restaurants or kitchens. In the temperate regions of the northern hemisphere the butterfly known as the Painted Lady is the most ubiquitous of its kind. It passes the winter in the adult state. Dr. Sharp tells us: "In the temperate regions of the northern hemisphere *Vanessa* may be considered the dominant butterflies, they being very numerous in individuals, though not in species, and being, many of them, in no wise discomfited by the neighbourhood of our own species. Several of them are capable of prolonging and interrupting their lives in the winged condition to suit our climate; and this in a manner that can scarcely be called hibernation, for they frequently take up the position of repose when the weather is still warm, and on the other hand recommence their activity in the spring at a very early period. This phenomenon may frequently be noticed in the tortoise-shell butterfly; it is as if the creature knew that, however warm it may be in the autumn, there will be no more growth of food for its young, and that in the spring vegetation is sure to be forthcoming. . . . It should, however, be recollected that many larvæ of butterflies hibernate as young larvæ after hatching, and, sometimes, without taking any food." As is well known, the activities of the inhabitants of the beehive, although lowered and to some extent in suspense, are still carried on. It is quite different with wasps and bumble-bees. The colony dies down and disappears; only the queen survives, and this she does in a motionless, inactive condition, hidden away in a crack in a tree or in a ditch. The majority of insects pass through the winter in a pupa or chrysalis stage, hidden away under leaves or buried in the ground. But as pupæ are generally inactive and motionless, the hibernation is not a very obvious alteration in their normal habits. Many beetles and several species of dragon-fly hibernate during the winter in a larval state, and as the former are very often found embedded in burrows in trees they do not require a special winter home. The larvæ of the dragon-flies and of the may-flies hide themselves in the side or muddy bottom of their native pools.

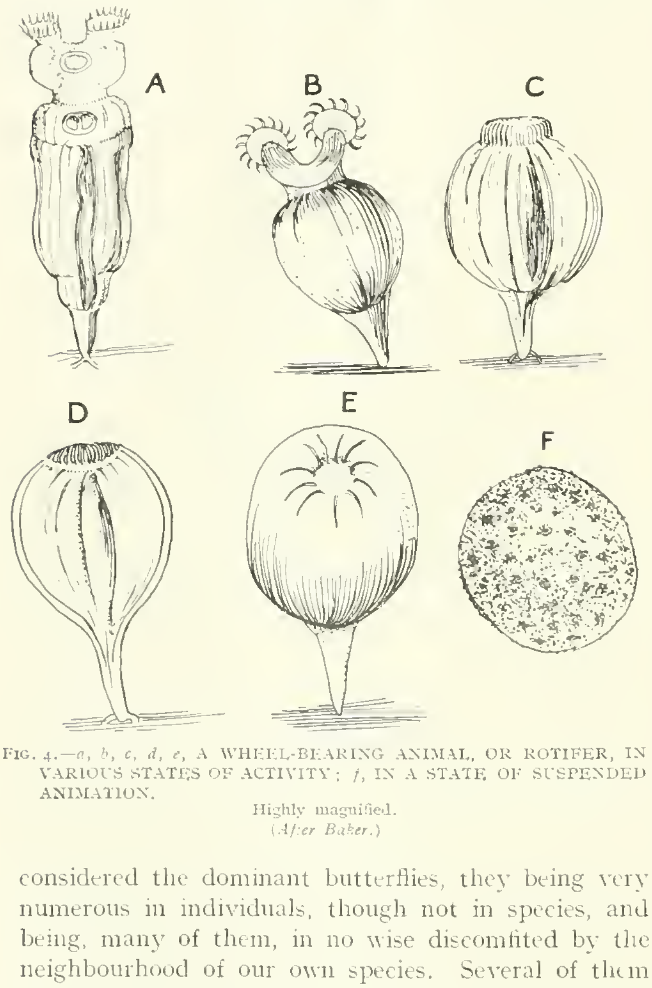

FIG. 4.—*a*, *b*, *c*, *d*, *e*, A WHEEL-BEARING ANIMAL, OR ROTIFER, IN VARIOUS STATES OF ACTIVITY; *f*, IN A STATE OF SUSPENDED ANIMATION.

Highly magnified.
(*After Baker.*)

Towards the close of autumn the whole insect world in temperate climates is on the move. Like the executive of the Government at Washington during the time of the Presidential Election with the parties changing sides, they are all "making for cover." Lady-birds, field-bugs, and flies have retired into their winter-quarters well before the first frost has occurred; very often on the hottest autumn days.

To those who are on the outlook, the coming together of numerous species of beetle on quiet autumn days is as striking as the assemblage of swallows before they take their autumn flight for sunnier climes. Kirby recalls that whilst "walking on the banks of the Humber on the 14th of October about noon—the day bright, calm, and deliciously mild, Fahrenheit's thermometer 58° in the shade—my attention was first attracted by the pathways swarming with numerous species of rove-beetles (*Staphylinus*, *Oxytelus*, *Aleochara*, etc.), which kept incessantly alighting, and hurrying about in every direction. On further examination I found a similar assemblage, with the addition of multitudes of other beetles, *Halticæ*, *Nitidulæ*, *Rhynchophora*. *Cryptophagi*, etc., on every post and rail in my walk, as well as on a wall in the neighbourhood; and on removing the decaying mortar and bark, I found that some had already taken up their abode in holes, from the situation with their antennæ folded, evidently meant for winter-quarters." The aphis passes the winter both in the egg and in the perfect state. All these insects fall into a coma. At first they are but partially benumbed, and when touched are still capable of moving their limbs. Soon,

however, the insect practically ceases to breathe, to feed, or to move. The muscles lose their irritability and they have all the appearance of being dead. Whereas in the case of the ROTIFERA and TARDIGRADA the suspension of life is due to the drying up of their watery surroundings, the hibernation of insects and snails, and—as we shall see later—of various forms of vertebrate animal, is due mainly to the onset of winter. It is a seasonal occurrence, though in many cases we shall notice that in the tropics, where animals retreat during the hotter months (æstivation), the hotter months coincide in time with the drying up of the surroundings.

(*To be continued.*)

[Our thanks are due to the proprietors of the *New York Evening Post* for permission to reprint portions of this article.—ED.]

Industrial Stability

By A. C. Pigou, M.A.

Professor of Political Economy in Cambridge University

A LEADING note of the industrial activity of modern states is its fluctuating character. Not only do we find from time to time one industry expanding while another decays, but also besides the *relative* fluctuations, there are more or less rhythmical fluctuations of an *absolute* kind in industry as a whole. It is these absolute fluctuations that economists are accustomed to refer to under the name of the trade cycle. They do not, of course, occur in the form of equal proportionate movements in each several industry. On the contrary, they are always combined with *relative* fluctuations occurring at the same time. In booms the constructional industries expand relatively to other industries, and in depressions they contract relatively to them. But, over and above these relative movements, there is also an absolute movement on the part of these two sorts of industries taken together, which is associated with fluctuations in the aggregate volume of work done throughout the country as a whole.

Now it could not be laid down *a priori* that fluctuating activity as such must be less favourable to human welfare than regular activity of equal aggregate amount. There is no reason, for instance, to believe that the world would be a better place if, instead of being wholly awake in the day and wholly asleep at night, people were half asleep all the time. Is there any more reason to believe that it is worse for people to work for three or four years very hard and then for three or four years rather slackly than it would be for them to work moderately hard every year? The answer, it would seem, must depend on the physical and psychological constitution of human beings, and could not, therefore, be derived from economic considerations alone. In actual life, however, the question is not put in this highly etherealised form. We know that, as a matter of fact, with industry organised as it is, periods of depression are associated, not with relaxed work for everybody, but with total unemployment for a certain number of people, and we know that, whatever there may be to say in favour of alternations of hard work and holidays, there is nothing to say for alternations of overtime and involuntary unemployment. No doubt, it is possible, by various palliative measures, to diminish substantially the social evil that unemployment carries with it. But, in spite of this, nobody seriously denies that, as things actually are in the modern world, general industrial fluctuations involve grave injury to welfare, and that, if somehow greater stability could be introduced, there would be a very large social gain.

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It is not difficult to show that, even if we had a monetary system so contrived as to keep the general level of prices approximately constant, some degree of cyclical industrial movements would still take place. There would be alternations of business confidence and business malaise; at one time all the various groups of people concerned in different sorts of production would over-estimate the rate at which their stuff, if they produced it, would exchange for other people's stuff; when the stuff, after a period of incubation, was finished and ready for trading, they would all discover their error; and, in consequence, pessimism and a period of contracted output would set in. Though, however, this is true, it is also true that the cyclical fluctuations of industry, which would thus take place even under a régime of stable general prices, are much aggravated when the monetary system is of such a sort that these prices rise in booms and fall in depressions. For the persons in control of industry are, in the main, debtors in terms of money, so that, when prices rise, the money payment they have to make in interest remaining the same, the real payment is diminished, and, when prices fall, the real payment is increased. This means that in periods of boom, when they are already somewhat over-confident, business men receive an additional fillip in the form of a bounty at the expense of their creditors; and in periods of depression, when they are already unduly pessimistic, they receive an additional discouragement in the form of a tax for the benefit of their creditors. Moreover, since business men generally foresee future movements rather better than the people from whom they borrow, they may look, when prices are rising, to obtain *new* loans on better terms than they could do if everybody's foresight was equal;

and, when prices are falling, to obtain them on worse terms. This adds still more to their cheerfulness in booms and to their despondency in depressions. The net result is that industry progresses in waves of an amplitude substantially greater than would appear if general prices were so chained that they could not rise in booms and could not fall in depressions.

The Gold Standard

From what has been said it follows that, other things being equal, industrial stability will be promoted the more effectively, the more fitted is our monetary system to ensure price stability both in periods of boom and in periods of depression. Before the outbreak of the Great War the money of the United Kingdom was based on the gold standard, and this fact prevented booms and depressions here from carrying general prices substantially above or below the contemporary level in the world generally. If they began to soar above this level, goods tended to flow into this country and gold to flow out, with the result that the upward movement was checked ; and, if they began to fall below this level, the downward movement was checked by a corresponding mechanism. In the face, therefore, of booms and depressions private to the United Kingdom, general prices were chained fairly tightly and could not move much. But, of course, in fact booms and depressions often extended much beyond the United Kingdom, and, when this happened, though domestic prices could not move far away from world prices, domestic prices and world prices might both move a long way from their original position.

In the difficult period of the Great War the gold standard was abandoned in effect in all the belligerent countries, and, though the money of the United States is now a full gold money, the moneys of the principal European countries are no longer convertible at their face value into gold, and the money of the United Kingdom, though nominally so convertible, is really placed on the same footing as the continental moneys by legal prohibitions against the export of gold and the melting of sovereigns. The abandonment of the gold standard implied a rupture of the chain by which upward and downward movements of general prices had hitherto been held in check. This made possible the enormous price swings that were associated with the post-war boom and the depression following it. If, indeed, the Bank of England had raised the discount rate earlier and higher than it did, the amplitude of these swings would have been lessened. There were special obstacles in the way of such action by the Bank at that time, and it may be argued that, in future booms, we might rely on general prices being chained down by discount policy not less effectively than they would be chained by the gold standard. Since, however, it is generally agreed that, in this country at all events, the gold standard must, on other grounds, be restored at the earliest possible moment, it is not necessary to argue that point. As a matter of history, the abandonment of the gold standard not only made possible, but was also in actual fact associated with, altogether abnormal swings in the general price level.

When we have got back to the gold standard, as, no doubt, we presently shall, there is some danger that the problem of price stabilisation, which has recently been much discussed, will be allowed to sleep. Happy in having escaped from our present ills and returned to pre-war currency conditions, we may be inclined to treat as academic and unpractical proposals designed to improve on these conditions. But, as I have shown above, the gold standard, though an effective chain upon price movements in booms and depressions private to a single country, is not effective in booms and depressions of world-wide scope. Plainly, therefore, pre-war currency arrangements were not perfect, and, if it should prove possible to improve on them, it is very desirable to do so. A number of plans to this end have been discussed among economists. Some of them involve international action, but others, at the cost of a number of rather serious disadvantages, could be adopted by a single nation. It would not be appropriate to examine the technique of these plans here. It is in place, however, to call attention to the fact that such plans exist. When England is once more back on the gold standard, our Government, in conjunction with that of the United States and of other interested countries, might very usefully set up an international Commission to investigate the whole subject.

Simple Remedies

It is not, however, only through price stabilisation that industrial stabilisation can be promoted. Governments—and under the term " governments " we must include municipal and other local authorities—have it in their power to contribute something towards that end in a simpler and more direct way. There is a large amount of work for the initiation of which, whether by themselves undertaking it or by ordering it from private contractors, they are themselves normally responsible. A good deal of this work is such that it does not very greatly matter whether it is done in one year or in another neighbouring year. By pressing on work of this kind in periods of depression and holding it back in periods of boom, government authorities can, if they choose, make industry and employment as a whole somewhat steadier than it would otherwise be. It is sometimes objected that

this kind of action could not really achieve the end sought by it because, whatever extra money government authorities spend on government work during depressions, must, in one way or another, be withdrawn from the funds which private people would otherwise have spent on private work ; so that, though a difference would be made to the type of work done in depressions, no difference would be made to its aggregate quantity. This argument, however, fails to take account of the elasticity of our banking machinery. That elasticity makes it possible from time to time for the money expenditures of one portion of the community to be substantially increased without those of the other portions being correspondingly diminished. It also fails to take account of the fact that, if a depression is allowed to run its normal course, government authorities will have to expend large sums in the relief of unemployed workpeople, and that, therefore, those funds are available for setting industry in motion to the extent that expanded industry diminishes the volume of unemployment. There are, of course, important difficulties of detail in the way of using government demand as a kind of balance wheel to offset oscillations of private demand, and it would be a mistake to expect too much from it. *In principle*, however, the policy is a sound one and is not open to objections of a fundamental sort.

Improvement in the monetary mechanism with the direct object of promoting steadiness in general prices and adjustment of orders on the part of government authorities are the most obvious and most frequently discussed means of increasing the stability of industry There are, however, other means, some of them in the control of individual manufacturers or groups of private consumers, by which a small contribution to the same end might be made. Individual manufacturers have a certain freedom as to the policy they will adopt about making for stock, and private consumers have the power, just as government authorities have, to adjust, in the general interest, the period at which some of their less urgent orders shall be given. We cannot hope, in any event, however strenuously everybody may work for that end, that the trade cycle will be smoothed out altogether. But there is reason to believe that more can be accomplished in this direction than has been accomplished hitherto. The subject is one that has not yet been fully investigated. It is difficult on the technical side, covers a wide range, and is interwoven with a number of matters that seem at first sight to have no relation to it. But, on the other hand, it has a very direct bearing upon the real welfare of the community ; and students of it may reasonably hope that their work, if successful, will yield fruit as well as light.

Plant Life in the Antarctic

By R. N. Rudmose Brown, D.Sc.

The prevalent belief that Antarctic regions are entirely devoid of vegetation is far from the truth. It arises partly from the meagre collections from the far south until recent years, and partly from the contrast with the comparatively rich vegetation of North Polar regions. It is true that the surface of the great Antarctic ice-cap which covers nearly the whole of the continent is devoid of plant or animal life, but around the edges of the continent where ice-free rocks appear, and on the islands which fringe it in places, vegetation is far from negligible.

The region which experiences true Antarctic conditions is bounded approximately by the parallel of lat. 60° S. To the north of this parallel lie the subantarctic regions comprising such island groups as South Georgia, probably the South Sandwich group, and certainly Kerguelen. Within the Antarctic region lies the whole of the Antarctic continent and such island groups as the South Shetlands and the South Orkneys. The Antarctic Circle is neither a geographical nor a climatic frontier, and it is entirely fallacious to regard it as the boundary of Antarctic regions.

The Antarctic flora, thus defined, has been examined in various places, and its general aspect is well known, even if subsequent exploration will undoubtedly add a few species of cryptogams. Its poverty compared with the flora of the same latitudes in North Polar regions is striking. While Arctic regions support some 400 species of flowering plants, many of which flourish luxuriantly, Antarctic regions support but two, neither of which does more than maintain a precarious hold. These species are a grass *Deschampsia antarctica*, and a small caryophyllaceous plant [1] *Colobanthus crassifolius*. The grass was first discovered in the South Shetlands, south of Cape Horn and Drake Strait, over a century ago by J. Eights, the surgeon of a sealing vessel. In recent years it was rediscovered on the west of Graham Land and on adjacent islands by both Belgian and French Antarctic expeditions, between lat. 65° S. and 68° S. It is known also from Fuegia, the Falklands, South Georgia, and Kerguelen. The other plant is a comparatively recent discovery, the French Antarctic expedition having found it in several places along with the grass. It, too, must be regarded as a straggler from Fuegia, where it is more at home ; it grows also in the Falklands and South Georgia.

[1] This is the order to which the familiar British plant, the white campion, belongs.

In spite of careful search in other parts of Antarctic regions, these plants have not been found elsewhere, although there is a possibility of their occurrence in the South Orkneys. They grow sparingly in scattered groups and give the impression of being almost at the limit of possible existence. Reproduction would appear to be entirely vegetative.

Ferns are entirely lacking in the Antarctic, but mosses are numerous and, in fact, are one of the chief constituents of the flora, in individuals if not in species. Well over fifty species are now described from Antarctic regions, of which the majority come from the Graham Land region and neighbouring islands. Many specimens show a vigorous, even luxuriant, growth, and this is specially notable in certain species that have a wide distribution throughout high latitudes. The specimens from Victoria Land in lat. 78° S. are stunted and miserable compared with those from Graham Land fifteen degrees farther north. In the far south they are frozen solid, as hard as rock, for some ten or eleven months, in Graham Land and the South Orkneys for seven or eight months, but this experience does not seem to impair their vitality. The mosses generally grow in small colonies, in favoured places, in which a number of species are to be found. In some cases a small tundra of moss and lichen vegetation half an acre in extent may be found. Such places are favourite nesting-places of skuas and gulls; the bird guano provides a valuable fertiliser to the moss. Most Antarctic mosses reproduce vegetatively [1]: fruiting specimens are rare. Dr. J. Cardot, the great authority on Antarctic mosses, says that among all the specimens he has examined only six species showed fruits. Even among the specimens from the South Orkneys, where moss growth is luxuriant, only one species showed many well-developed fruits

Antarctic hepatics or liverworts are rare. The half-dozen or so of species seem all to have been recorded from the Graham Land region. They are generally found growing in the shelter of moss colonies. Lichens are numerous, and both as species and individuals form the predominant feature of Antarctic plant life, marine algæ excepted. Even in mid-winter a few precipitous rock faces may show a touch of colour due to lichen growth, while in summer there are great patches of brilliant orange, due mainly to various species of *Placodium*, and shaggy growth of a luxuriant species of *Usnea*. There are few, if any, areas of bare rock in summer which do not support some lichen growth. Dr. O. V. Darbishire has recorded over 100 species of lichens in Antarctic regions. Subsequent exploration will certainly add to this number.

[1] Vegetative reproduction is shown by plants which, like the begonia, can multiply without the production of seeds.

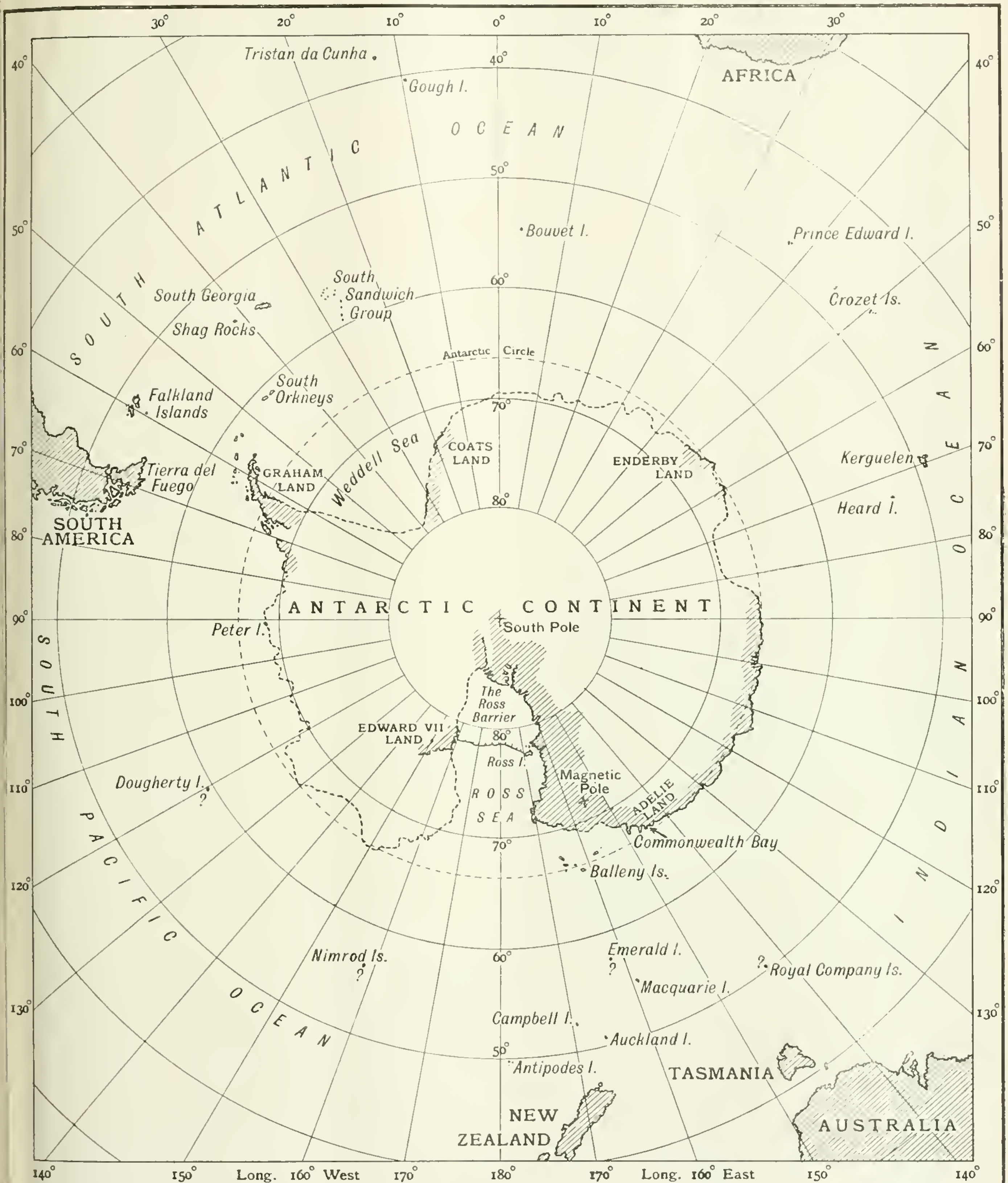
Red Snow

Fresh-water algæ are comparatively abundant. In the South Orkneys alone sixty-eight species were recorded. The forms of most interest are those that give origin to red and yellow snow. Red snow is not very common, but has been recorded from various parts of Antarctic and Arctic regions, as well as from extra-polar regions. Dr. Fritsch, on examining South Orkney material collected from a patch of red snow, found it to be due to an algal association; but in Victoria Land Mr. J. Murray attributed the colour not to algal growth, but to the presence of red rotifers. These have been found in red snow in the Alps, but, as far as I am aware, not in Arctic regions. Yellow snow is rare. At the South Orkneys it is due to a remarkable association of eighteen species of algæ and two of fungi, with a character so reminiscent of plankton [2] that it may be due to wind carriage of plankton forms on to the land. This must not be confused with the yellow coloration of sea-ice which is due to included diatoms. In yellow snow diatoms are rare.

Marine algæ are very abundant in Antarctic seas. As in Arctic waters, the rock pools and shore-line generally are comparatively free from seaweeds owing to the scouring action of the ice. This gives a false impression of the poverty of marine life. In water over 10 or 15 feet in depth there are many seaweeds; in shallow water only calcareous algæ encrusted on the rocks are at all conspicuous.

Unicellular marine algæ occur in enormous numbers. Sir J. Hooker was the first to demonstrate this phenomenon, and since his day every expedition has corroborated his statement, though comparatively few have made exhaustive collections. South of lat. 60° S. the plankton changes its character: animal forms become scarce and plant forms predominate. In the regions of pack-ice diatoms and a few peridinians constitute the surface life of the sea. A few minutes' haul of a fine silk net results in half a pint to a pint of gelatinous matter which is almost wholly composed of diatoms. Some ten or twelve species are very common, and some forty to fifty are rarer. The Arctic seas show the same abundance of diatoms, sometimes to such an extent that the sea appears bright green for several acres. This discoloration of the sea has seldom been recorded in the Antarctic. It is of interest to note that Dr. L. Mangin finds on comparison that the Arctic and Antarctic diatom floras are practically distinct as regards species, and that there is also much difference in various parts of Antarctic seas.

[2] "Plankton" is a general name given to those minute forms of sea life which exist either on or just below the surface of the ocean.



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Antarctic and Arctic Contrasts

The contrasts between Antarctic and Arctic land floras are very notable and demand explanation.[1] The extent of insolation is of course the same in corresponding latitudes in northern and southern hemispheres. The annual snowfall in the south is probably not greater than in the north, and the winter temperatures, at least in certain parts of Antarctic regions, are not more severe than in parts of Arctic regions. The real explanation is to be found in the short summer with its remarkably low temperatures. Thus in Victoria Land in about lat. 78° S. the mean of the warmest month of the year is only 25° F.; at Cape Adare in lat. 71° 18′ S. it is 31·5° F.; at Snow Hill, Graham Land, in lat. 64° 24′ S. it is 30·4° F.; and at the South Orkneys in about 61° S. it is 32·9° F. Thus there is practically no month in the Antarctic with a mean temperature above freezing-point, while the mean of the three summer months, December, January, and February, is everywhere below 32° F. In Arctic regions summer is warmer and longer. The mean summer temperature (June, July, and August) in Spitsbergen is over 37° F., and the mean of the warmest month, July, is over 40° F. In Franz Josef Land in lat. 80° N. the July mean is 35° F. In other words, the Arctic summer has a mean well above freezing-point.

This lack of a real summer influences Antarctic plant life in two ways. The winter snow lies late on the ground, and December is generally well advanced before most of the vegetation is laid bare and exposed to sunlight. By early February snow again begins to accumulate, and it may cover the ground throughout the so-called summer. There are only some four to six weeks during which the vegetation, except lichens on cliff faces, is likely to be exposed to the sunlight, and the probability is that the ground has a temperature not above freezing-point even if it is not saturated with ice-cold water: often it thaws only for a few hours on cloudless days when the sun is strong. These influences are detrimental enough to plant life, but the impossibility of completing the cycle of life-functions in the short cold summer causes the virtual absence of flowering plants. A plant would be unlikely to reach the flowering stage and would have no chance of maturing its fruit. Even Arctic plants in their more favoured circumstances rarely ripen their seeds and frequently reproduce vegetatively. With an average of eight to ten weeks, when the ground at low elevation is free from snow, Arctic plants have to "rush" their life-cycle, flowering frequently before the snow is off the ground, and even then finding the summer too short. Antarctic conditions, with low temperatures and the uncertainty of even four weeks clear of snow, deny even this possibility.

[1] See article on "Greenland's Plant Life," by Prof. A. C. Seward, DISCOVERY, September 1922.

Winter temperatures fall very low, but there is no reason to suppose that a mean of – 30° F. is any more prejudicial to plant life than a mean of zero. Throughout the Antarctic winter all temperatures are uniformly low enough to give all mosses the hardness of rock.

These probably are the main reasons of the poverty of the Antarctic flora, but there are contributory factors. The chief sites for plant growth are the islands, particularly small ones, and the rocky coasts. In such places high winds help to keep the surface clear of snow, but these high winds, not infrequently dry and generally cold, are themselves detrimental to plant growth. Nothing could be more hostile than the strong southerly and south-easterly winds blowing from the high-pressure system over Antarctica. The lack of soil has been suggested as an adverse influence. This is doubtful if one considers the habitat of many Arctic plants which, for example, in Spitsbergen maintain a hold on raised beaches, moraines, and even on rock faces. In places the level plain of the Antarctic provides 6 to 8 inches of soil, often well impregnated with bird guano, which might furnish suitable sites for the flowering plants. The Antarctic, however, has one influence hostile to plant life that is absent in the Arctic. In summer myriads of penguins haunt the islands and coasts of Antarctica, occupying all the low-lying sites that are first to lose their snow, that is to say, exactly the best sites for plant growth. In the proportion of one per square yard the penguins cover every available site; nothing escapes their insatiable curiosity or fails to be attractive to their beaks. No plant that had gained a footing would stand the smallest chance of surviving. It is not unreasonable to regard the penguin as one of the agencies hostile to plant growth in the Antarctic.

The Origin of Antarctic Flora

The origin of the Antarctic flora presents a fascinating problem. How did these species of plants reach Antarctica? It would occupy too much space to analyse in detail the distribution of every Antarctic species, but it may be noted that certain elements are conspicuous. There are the endemic element, which is high in the case of mosses and lichens; the Arctic element; and the Fuegian element. The high proportion of endemic species can well be explained by long isolation and peculiar conditions of environment. The Arctic element is not easy to explain. Two suggestions have been made. Carriage of spores and soredia in the feet and plumage of birds which wander through 150° of latitude may account for some species. Wilson's petrel and the Arctic tern are birds with this

wide range. At the same time it is difficult to find in this means an adequate explanation of the fact that practically half the Antarctic lichens and 30 per cent. of the mosses are found also in the Arctic. A simpler and more credible explanation may be found in the idea that the species in question are either cosmopolitan and have not been discovered in low latitudes, or that they are species which have been crowded out by stress of competition in low latitudes where conditions more favourable to plant growth mean more contest for location.

There seems to be much evidence that the present Antarctic flora, like the sub-antarctic flora, is mainly of Fuegian origin, and has migrated eastward before the prevailing westerly winds, both bird and wind transport having played their parts. Ice transport plays no part outside the pages of a few textbooks. This evidence I have analysed elsewhere, and there is no reason, in the light of later knowledge, to modify the conclusions. It might, however, be noted that former land connections which there is every reason to believe connected Antarctica at least with South America, if not New Zealand and Australia, cannot be held responsible for any of the present Antarctic flora. Apart from the fact that these land connections probably were lost in Tertiary times, there is ample evidence that a great extension of glaciation occurred at a later date. This must effectively have destroyed every vestige of vegetation in Antarctic regions. The present flora must have migrated to the Antarctic in recent geological times, since the period of maximum glaciation.

The literature of Antarctic botany is considerable. For a discussion of the origin of the flora reference may be made to " Problems of Antarctic Plant Life," R. N. Rudmose Brown, in *Report on Scien. Results S.Y. Scotia*, vol. iii, 1912, and papers in same volume by J. Cardot on Mosses, F. E. Fritsch on Fresh-water Algæ, and O. V. Darbishire on Lichens. Contributions of importance occur in *Wissen. Erg. der Schwedischen Südpolar Exp.*, vol. iv, including J. Cardot on Moss flora, O. V. Darbishire on Lichens, and C. Skottsberg on Algæ ; and in *British Antarctic Exp.*, 1907–9, *Report on Scien. Invest.*, W. and G. West on Fresh-water Algæ.

The Bacteria of the Soil

And the Utilisation of Organic Antiseptics

By P. H. H. Gray, M.A.

Rothamsted Experimental Station

The great importance to plant-life of the presence of bacteria in the soil was first recognised in connection with their powers of dealing with that vital element, nitrogen. It is now well established that there are bacteria present which have the amazing property of " fixing " the nitrogen of the air, and handing it over to plants in a form of which they can make use ; and not one process, but a whole chain of processes, is involved in their many-sided activities. It is not easy to see how life could ever have been developed to its present scale apart from them.

A less friendly bacterium from the agriculturist's point of view is that which competes with crops for the nitrates present in the soil. The decomposition of the cellulose which forms the framework of plants has engaged the attention of McBeth and Scales in America and of Hutchinson and Clayton at Rothamsted, and important knowledge has been acquired as to the action of carbohydrate substances such as sugar and straw, which are present as the residues of former crops, and which serve the bacteria as a source of energy sufficient to enable them to use the nitrates for their own purposes and to deprive the crops of them.

Carbohydrates, however, are not the only nitrogen-free organic compounds that occur in the soil. Other compounds, though present in smaller quantities, may be of considerable importance. Phenol, which we know better under the name of carbolic acid, and related compounds are found in the soil, being formed by bacterial action in the intestines of animals and probably even in the soil itself. The amount of phenol produced, though small, is by no means negligible ; thus Mooser calculated that with a dressing of liquid manure anything from 30–74 lb. of phenol may be added to the acre. Such compounds, if they persisted in the soil, would accumulate, and ultimately prove a source of plant poisoning. Dr. Brenchley at Rothamsted has, indeed, shown that in water-culture experiments the addition of small doses of phenol is poisonous to plant growth. The disappearance of phenolic compounds even from heavily manured soil indicates that a mechanism must exist by which they are removed or destroyed.

The Disappearance of Antiseptics

The problem of the destruction of phenol compounds in soil became of practical importance owing to the use of such substances in the tomato-growing industry as soil-sterilising agents. In glass-houses, cresylic acid, which is a substance of this kind, is applied to the soil for the purpose of killing such destructive tomato pests as the eel-worm, Heterodera. It is found, however, that unless added in strong concentrations, phenol and cresol disappear from the soil with considerable rapidity, so that their full effect on the pests is not felt. A parallel case is that of naphthalene, which

forms the basis of some soil insecticides. The full utility of this compound, also, is impaired by the fact

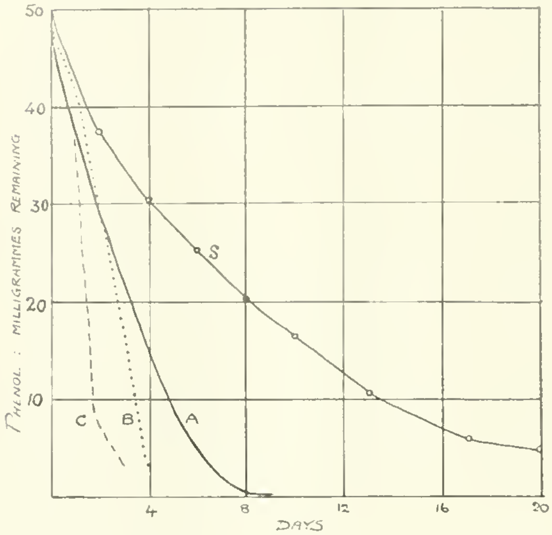

FIG. 1.—DISAPPEARANCE OF PHENOL FROM MANURED SOIL.
S = Disappearance from sterilised soil.
A, B, C = Disappearance of three successive doses from a single soil sample.
(After Sen Gupta.)

that it disappears too rapidly when added to the soil. The cause of the disappearance of these antiseptics from the soil was therefore studied at Rothamsted with the object of preventing their rapid loss, and so prolonging their antiseptic action.

A study of the disappearance of phenol, from the chemical point of view, was made by Sen Gupta, who found evidence that two causative factors were involved, a purely chemical or physical cause, and a biological cause. If a dose of phenol be added to soil in which all the bacteria have been killed by treatment with mercuric chloride, the disappearance is at first rapid, but soon takes place at a slower rate. Evidence has been adduced that this disappearance is due to the reaction of the phenol with a chemical substance in the soil. In normal unsterilised soil, on the other hand, the disappearance of the same dose of phenol is much more rapid and follows a less regular course. A second factor causing the disappearance has therefore been removed by the sterilisation. The probability that this factor is biological is shown by the fact that if three successive doses of phenol be added to the same sample of soil, the second dose disappears more rapidly than the first, and the third more rapidly than the second. This is what would be expected if the disappearance were due to organisms multiplying in the soil following the addition of the phenol, but it is very hard to explain on the supposition that the disappearance is purely chemical or physical. The curves in Fig. 1 show graphically this accelerated loss.

The Function of the Bacterium

Evidence of this type has led the Bacteriology Department at Rothamsted to search for phenol- and cresol-destroying bacteria in the soil. The existence in nature of certain bacteria capable of attacking phenol was already known. On sewage filters the phenol, which is known to be formed by bacteria, does not accumulate, and this fact led Fowler, Ardern, and Lockett in 1910 to study the subject of its disappearance. They were successful in isolating an organism capable, in pure culture, of feeding upon phenol. Later, Wagner in Germany isolated from various sources bacteria which could utilise benzene ring compounds, a class to which naphthalene belongs, as supplies of energy.

An examination of the soils around Rothamsted showed that they contained soil bacteria capable of attacking phenol, cresol, toluene, and naphthalene in pure culture. The organisms that have been isolated can use some or all of these compounds as the source of energy for carrying out their life-processes, and are able to grow rapidly in a solution containing the antiseptic and no other food supply than inorganic salts. Since the phenols are strongly antiseptic in their action on most bacteria, it is especially remarkable that organisms commonly occur in the soil that can feed on these compounds. The decomposition of naphthalene by soil bacteria is even more remarkable, since it is inconceivable that the bacteria can meet with it to any significant extent in a state of nature.

FIG. 2.—BACTERIA WHICH DECOMPOSE ANTISEPTICS GROUP D. × 1,000.

Having found that bacteria capable of attacking organic antiseptics occurred in Rothamsted soil, it was necessary to decide, firstly, whether similar

organisms were common in other soils, and, secondly, which of the various bacteria isolated were of chief importance in causing these antiseptics to decompose in the soil itself. To settle this first question, about 150 soil samples were collected, with precautions to exclude outside contamination, from a wide area in Great Britain, and the phenol, cresol, and naphthalene bacteria were isolated from them. It was found that, although some 200 strains of antiseptic-decomposing bacteria were obtained from over this wide area, they fell into four main groups, three of which had already been found in Rothamsted soil.

These groups were :

A. A number of Pseudomonads similar to the common organism Ps. fluorescens-liquefaciens.

B. A few varieties of small rod-like bacteria.

C. A number of large rod-like forms that produced spores.

D. A group perhaps related to the tubercle bacillus.

These latter organisms undergo remarkable changes in appearance under cultural conditions. (See Fig. 2.)

Geographical Range of Bacteria

The first three groups appear to be widely distributed over Great Britain, but the last group has an interesting and so far unaccountable geographical range, since it is apparently not evenly distributed over the area searched, being abundant in the south-east and middle of England and in the Edinburgh and Glasgow area, but very rare in the North of England and in the rest of Scotland.

Phenol and naphthalene organisms are also known to occur in soils from other countries, having been found in soils from Norway, the Tyrol, and Gough Island in the South Atlantic. As it appears, therefore, that they are of world-wide occurrence, there is reason to suppose that the results of the study of phenol, cresol, and naphthalene decomposition at Rothamsted will be applicable to other parts of the world.

The second question—namely, as to which group of organisms is chiefly effective in decomposing these antiseptics in the soil itself—cannot be considered as finally settled. If a dose of phenol be added to manured soil, it produces at first a slight fall in the numbers of bacteria followed by a very rapid increase, the numbers sometimes reaching astonishing proportions. This quick rise does not take place, nor does the phenol disappear so rapidly, in soil from which the phenol bacteria are absent. The bacteria which are involved in this great multiplication are all of the Pseudomonad type of phenol-destroying organisms. There is thus reason to suppose that this is the type of organism which is of chief importance in the soil. On the other hand, the increase in the organism does not begin until about half the added phenol has disappeared, as can be seen from the chart (Fig. 3). There is still the possibility, then, that another group of micro-organisms that are not revealed by the counting technique at present employed may be attacking the phenol. The work on these bacteria is not, however, as yet completed, so that a full account of it cannot be given, but will appear elsewhere in due course.

The addition to the soil of such organic antiseptics as these we are considering produces an important effect beside that of destroying plant pests. In normal soil not treated with antiseptics, the bacteria which produce available plant food are in a state of equilibrium with the population of soil protozoa. It has been

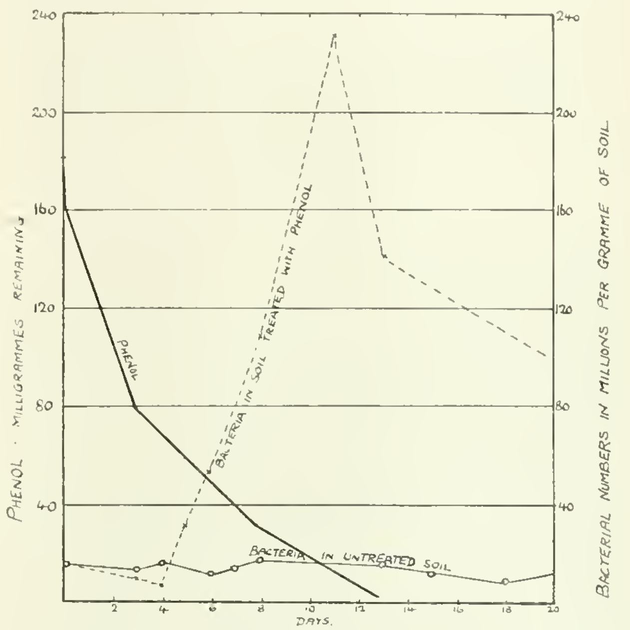

FIG. 3.—INCREASE IN NUMBER OF BACTERIA IN SOIL TREATED WITH PHENOL.

found by the Protozoology Department at Rothamsted that, in a field soil, increases in the numbers of actively feeding amœbæ are accompanied by decreases in bacterial numbers, and vice versa. Now, the addition of a mild antiseptic to the soil disturbs this equilibrium between Protozoa and Bacteria, enabling the latter to increase. Thus Russell and Hutchinson found in 1909 that the addition of toluene to soil caused an increase in bacterial numbers and a corresponding increase in ammonia and nitrate available to the plant as food. It is thus possible to increase the fertility of the soil by the addition thereto of a mild antiseptic.

The study of the effect of adding these organic antiseptic compounds to the soil is therefore of importance, not only with a view to their use for destroying soil pests, but also because it promises to throw light

on the balance of activities between the various groups of soil micro-organisms, and there is reason to believe that this balance is a fundamental factor in the fertility of the soil.

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The Franco-Russian Alliance

By R. B. Mowat

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THE alliance between France and Russia (1894 to 1917) was, throughout its duration, even more of a European mystery than the famous *Triplice* of Germany, Austria, and Italy. Although the documents of the Triple Alliance were not published until 1919, careful observers (like M. Herbette in Albin's *Grands Traités*) were able to make surprisingly accurate guesses or inferences. With regard to the Franco-Russian Alliance nearly all the inferences made by historians and journalists turned out to be wrong. Meanwhile the lips of the very few French and Russians who knew the facts remained absolutely sealed. It was not until the War and the Russian Revolution had put an end to the Franco-Russian diplomatic system that the French Government, in order to disprove the misrepresentations of writers and speakers, published the facts in an official Yellow Book.

The makers of the Franco-Russian Alliance were M. de Giers on the Russian side, and M. Ribot and M. de Freycinet on the French side. The object of these statesmen in framing the Alliance is fairly clear: it was that their respective countries might live in security. Nobody could seriously bring forward the charge that the Franco-Russian Alliance aimed at attacking anyone; for the Alliance endured so long, and was supported by so many different Ministries, one after another, in Russia and in France. An aggressive alliance can be made for a particular time and object; but an alliance which goes on year after year, as it were indefinitely, cannot by the nature of things be meant to attack anyone.

From 1872 to 1894 France stood alone and was practically at the mercy of Germany. She was really only protected by the common sense and moderation of Bismarck and his school, and by the public opinion of Europe. But France could not permanently rely on these things. In 1875 Bismarck became alarmed at the apparent revival of France and appears to have been on the point of declaring a war, which France would probably have totally failed to resist. In this instance war was actually averted by the friendly intervention of the British Foreign Office and Russian Chancellery.

In the early 'nineties, France had attained a position in Europe which enabled her to offer considerable inducements to Russia, in order to make an alliance. Russia required capital for railways. France wanted military security. Both Powers were interested in maintaining European peace, but Russia seemed to be so strong that nobody thought she required France's military help.

The Tsar Alexander III, like his father, Alexander II, was a peaceful man. But it was not the Tsar alone who counted; it was the vast bureaucratic machine through which Russian policy had to be administered. At the head of this bureaucracy in the 'nineties was M. de Giers.

Since the year 1882, on the retirement of the aged Gortchakoff, M. de Giers had been Russian Minister of Foreign Affairs. He was a tremendous worker. He had mastered all the detail of the Chancellery; he was capable, silent, and self-effacing, and in no way tried to impose his views on the Tsar. Actually the views of Alexander and of his Minister of Foreign Affairs coincided: they both wanted peace, and the maintenance of the *status quo*. One of the good qualities of M. de Giers was that he did not allow his delight in the labour at his table in the foreign office to deter him from travelling—one of the most beneficent directions into which the activity of a really peace-loving Minister can be directed. M. de Giers was indefatigable in his visits to the Capitals of the Great Powers of Europe—to Rome, Paris, Vienna, Berlin. Towards the idea of a military alliance with France he appears not at first to have been particularly favourable; but after conversations between himself and M. de Laboulaye, French Ambassador at St. Petersburg in 1891, he became convinced that a Franco-Russian alliance could be made to contribute to the stability of Europe.

The First Advances

The documents which have been published by the French Government trace the formation of the momentous alliance from the summer of the year 1891. The first important document in the collection is a letter,

dated August 21, 1891, from M. de Giers to M. Mohrenheim, Russian Ambassador at Paris. This letter calls attention to two recent events; the first was a series of conversations at St. Petersburg between M. de Giers and M. de Laboulaye (who was actually on the point of retiring from the Embassy at St. Petersburg to give place to M. de Montebello). The second fact was the supposed (and, as it is now known to be, *correctly* supposed) renewal of the Triple Alliance (see DISCOVERY for December 1922, p. 316).

In view of these facts, M. de Giers thought it advisable that France and Russia should "define and perpetuate the *entente cordiale*" which united them. He therefore made two suggestions: namely, that the two Governments should agree (1) to "deliberate in concert upon all questions of such nature as to put the general peace in jeopardy"; (2) "to act in concert upon those measures which the realisation of that eventuality would make it necessary for both Governments to adopt immediately and simultaneously."

This letter, when passed on by M. Mohrenheim to M. Ribot, French Minister of Foreign Affairs, elicited an answer on August 27, 1891. This answer states that the points in M. de Giers's letter had been "previously contrived and formulated by common agreement of the two Cabinets" (of Paris and St. Petersburg). The *entente* of France and Russia was therefore to be made more specific, so as to become something of the nature of an alliance. M. Ribot accordingly accepted the two suggestions contained in M. de Giers's letter of August 21, and concluded by saying that the problems arising out of this closer union would have to be confided to the "practical study" of "special delegates."

The result of this practical study appeared almost exactly a year later when, on August 18, 1892, the Russian Chief of Staff, Obroutcheff, and the French Sub-Chief of Staff, Boisdeffre, signed a Military Convention at St. Petersburg. The preamble stated that:

> France and Russia, animated by a common desire to preserve the peace, and having no other end in mind than to ward off the necessities of a defensive war provoked by an attack of the forces of the Triple Alliance against either of them, have agreed upon the following provisions.

The main provisions were that if France was attacked by Germany (or by Italy supported by Germany), Russia should come to her aid; and that if Russia were attacked by Germany (or by Austria supported by Germany), France would come to her aid. The two Powers were not to conclude a separate peace. The Convention was to have the same duration as the Triple Alliance. This Convention was "definitively adopted in its present form" by exchange of letters between M. de Giers and M. de Montebello (French Ambassador at St. Petersburg) on December 27, 1893, and January 4, 1894.

M. Delcassé's Part

The next change in the Franco-Russian Alliance comes with the period of M. Delcassé as *Ministre des Affaires étrangères* (1898–1905). M. Delcassé made the aim of his public life to assure the safety of France. This he aspired to do by drawing the alliance with Russia closer, and by arranging either an alliance or "entente" with Great Britain.

In a letter of August 12, 1899, to President Loubet, Delcassé pointed out the weak spot in the existing Franco-Russian Alliance: the clause concerning duration which limited the Alliance to the duration of the Triplice. If, for instance, wrote M. Delcassé, the Austrian Empire should break up at the death of Francis Joseph, the Triplice would dissolve and with it the Franco-Russian Alliance: "born of the Triple Alliance, it would vanish with it."

> "What would happen," asked M. Delcassé, "if Austria were threatened by a dismemberment which, perhaps, is after all desirable, which perhaps might be countenanced and which, in any case, one might become anxious to turn to account? What could be more capable of compromising the general peace and of upsetting the balance between the European forces? And what situation, furthermore, would deserve to find France and Russia, not only united in a common plan, but ready even for its execution? Now it is just at the precise moment when the military convention should work, that it would cease to exist: born of the Triple Alliance, it would vanish with it. That is a deficiency which has constantly troubled me since I became Minister of Foreign Affairs."

M. Delcassé had already discussed this with Count Muravieff (Russian Minister of Foreign Affairs who had succeeded M. de Giers) at Paris in October 1898. The visit of the Russian Foreign Minister had been returned by Delcassé, who arrived at St. Petersburg on Friday evening, August 4, 1899. On Sunday, August 6, M. Delcassé had breakfast with the Tsar Nicholas II at Peterhof. Nicholas commented with esteem and approval on Delcassé's judicious conduct in the last Franco-British crisis (the Fashoda affair). The two statesmen then discussed the Franco-Russian Alliance: "I revealed to the Emperor my belief and apprehension that the Alliance would be disarmed in case one of those very events should arise in view of which it was formed."

The Tsar admitted the reasonableness of M. Delcassé's argument.

> At that moment I took the liberty of submitting to the Emperor the draft of a declaration which I had drawn up this morning. In it the arrangement of 1891 is confirmed; but the scope is singularly extended.

The Tsar was inclined to agree that his own idea was the same as M. Delcassé's. He called in Count Muravieff, who was waiting in attendance in another room.

> An understanding already existed between the Minister of Foreign Affairs and myself on the fundamental basis of the plan. It was decided that the new arrangement, of which the contents and the very existence should remain absolutely secret, should be established undeniably in the form of letters which Count Muravieff and I would exchange. (Delcassé to Loubet, August 12, 1899.)

The "new arrangement," which, as M. Delcassé said, "singularly extended" that of 1891, was to make the Military Convention endure as long as the diplomatic agreement.

As originally made in 1891, the Franco-Russian Alliance consisted of (1) a diplomatic agreement for deliberation and action in concert when the general peace was in jeopardy; and (2) a military convention, to endure as long as the Triple Alliance. But now (August 9, 1899) by exchange of letters between M. Delcassé and Count Muravieff it was agreed (1) "to confirm the diplomatic arrangement formulated in M. de Giers's letter of August 21, 1891," and (2) to "agree that the draft of the military convention . . . shall remain in force as long as the diplomatic agreement concluded to safeguard the common and permanent interests of the two countries."

This was not quite all. The new arrangement extended the *scope* of the alliance. In 1891 the two Governments had agreed to "deliberate in concert upon all questions of such nature as to put the general peace in jeopardy." But in the letters of August 9, 1899, they declared, in the preamble to the new arrangement, their motive to be the maintenance of "the general peace and the balance between the European forces."

From the published documents it has become perfectly clear that the specific and the defined object both of the Triple Alliance and of the Franco-Russian Alliance was the maintenance of the *status quo* in Europe. If that *status quo* came to be threatened by the probable or imminent dissolution of the Austrian Empire, the Franco-Russian alliance was to ensure that out of the ensuing settlement, the territorial weight of the Great Powers should still be kept in balance.

Thus the *Triple Alliance* was meant to preserve the Austrian Empire. The *Franco-Russian Alliance* came to mean that, in the eventuality of the dismemberment of the Austrian Empire, something like the previously existing balance of power in Europe should ensue or be maintained. Therefore, each in their own way, the Triplice and the Franco-Russian Alliance aimed at peace. That they failed to ensure peace shows that it would be better if the system of separate diplomatic groupings could be replaced by a system of general diplomatic grouping in the League of Nations.

[NOTE.—The most important documents of the French Government Yellow Book have been translated and printed by the Association for International Conciliation of New York, U.S.A., in its publications for the year 1919, vol. i. It is from this source that the extracts given in the present article have been taken.]

Invisible Light

Its Physiological Effects and Practical Applications

By J. S. Dow

IT is common knowledge that the portion of the spectrum that we recognise as visible light forms only a "special case" of electrical waves. Just as a wireless receiver can be tuned with a maximum response to a certain wave-length, and a diminishing sensitiveness to the waves on their side of this maximum value, so the eye is most sensitive to the yellow-green rays in the visible spectrum; and the luminosity becomes less as we approach the red on the one side, and the violet on the other. Indeed, the curve showing the sensitiveness of the eye throughout the visible spectrum and the corresponding curve connecting response and wave-length of a wireless receiver resemble each other very closely; this has led some observers to conjecture that the light-perceiving apparatus in the human eye has much in common with a detector of electro-magnetic waves, such as that used in wireless telegraphy.

On either side of the visible region of the spectrum there are radiations which are non-luminous, but may yet have an important influence on the human body, and possess important industrial applications. As we pass from the limit of visible red to the "infra-red," radiations with a wave-length greater than that of "light," we find radiations which are distinguished mainly by their heating effect. As the writer's previous article [1] indicated, such radiation forms a considerable proportion of the energy emitted by most incandescent illuminants. Not a great deal is known regarding

1 "Artificial Light—its Production and Application," DISCOVERY, February 1923, p. 44.

its physiological effects. Medical heat-baths, in which the patient stands in a cabinet surrounded by a mass of incandescent lamps, have been devised, and the ordinary electric radiator emits almost exclusively rays of this nature. Common experience suggests that the infra-red radiation present in most artificial illuminants has no material prejudicial effect on vision, provided the sources are not brought too near the eyes and are used discreetly. But continual exposure of the eyes to glowing masses at close quarters is doubtless bad, and the cataract that is somewhat prevalent amongst glassworkers and others who work in close proximity to incandescent material has been ascribed to this cause.

Much farther down the scale we come to the electromagnetic waves used in wireless telegraphy and telephony, and between there exists a wide range of infra-red radiations of whose properties little is definitely known.

human body furnishes an appreciable amount of heat, instruments which can measure very small quantities of heat could be used to detect the approach of an enemy at night. It is stated that by this device men were easily observed at a distance of 600 feet, and that a person lying on the ground 400 feet away was detected unerringly as soon as he lifted his head above the ground. Thus enemies creeping towards the trenches in the dark could be noted and a warning given. The method is also stated to have found some use in detecting the approach of hostile aircraft, and also as a basis of secret signalling. Experiments on the use of rays at the other extreme end of the spectrum, the ultra-violet, for secret signalling have also been made by the U.S.A. Army, and no doubt much work of a similar nature was also done for the British forces.

The most striking effects of ultra-violet light are met with in mountainous regions. These rays are

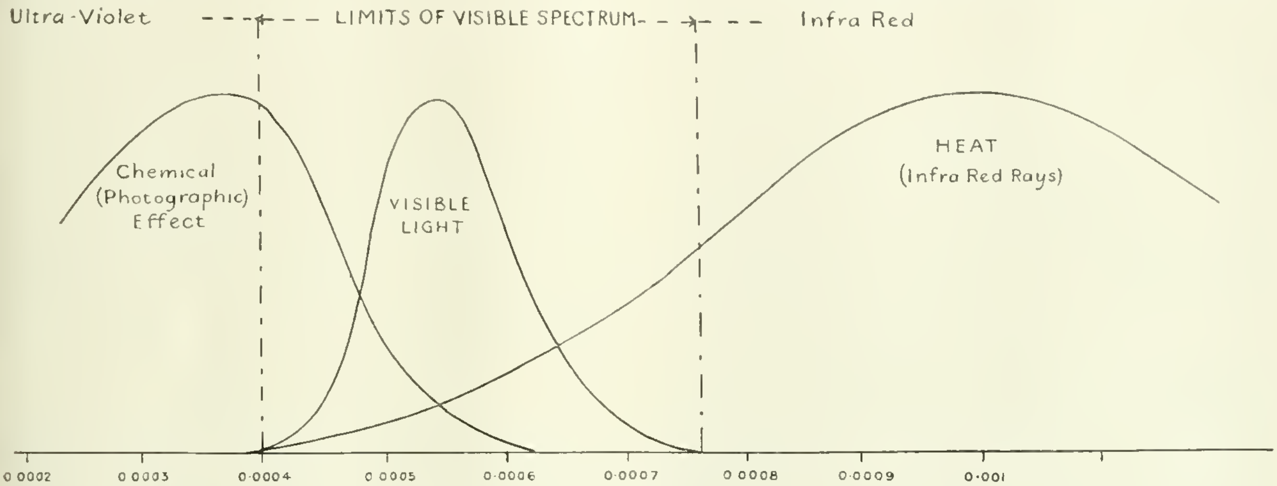

FIG. 1.—SHOWING ROUGHLY THE DISTRIBUTION OF HEAT, LIGHT, AND CHEMICAL (PHOTOGRAPHIC) EFFECT THROUGHOUT THE SPECTRUM.

The three effects of radiation in the visible and adjacent parts of the spectrum with which we are most familiar are heat, light, and photographic effect. These are distributed roughly in the manner indicated in Fig. 1. Interest centres chiefly on the invisible rays of wave-length shorter than the extreme violet—the "ultra-violet" which plays a considerable part in promoting chemical action as illustrated by the effect on the ordinary photographic plate.

Apart from their use as a curative agent, or for heating dwellings, infra-red rays adjacent to the spectrum have not as yet found many practical applications. But a highly interesting application of such rays occurred during the war. It occurred to several investigators connected with the U.S.A. Trench Warfare Research Division[1] that, as the

[1] *Physical Review*, August 1919.

rapidly absorbed by the earth's atmosphere so much so that experimenters with rays of very short wave-length have found it necessary to cause them to pass their instrument through an evacuated glass tube. In the rarefied atmosphere at high altitudes the effect of these rays, accentuated by reflection from the snow, is very evident, and mountaineers now habitually use goggles to protect their eyes, and a mixture of lanoline and pigment to cover their skin. The influence of altitude is well shown in the accompanying diagram, based on Professor S. P. Langley's observations at the base and the summit of Mount Whitney in the Sierra Nevadas, 15,000 feet high.

Light Sources and Ultra-violet Light

Although the great majority of artificial sources of light, which depend on incandescence, furnish little

ultra-violet, there are certain sources which are relatively rich in this radiation. Amongst these may be mentioned certain arc lamps having carbons cored with metallic materials which impose ultra-violet lines over the ordinary spectrum. Such sources have been used in kinema studios, where the richness in ultra-violet light is useful on account of the enhanced actinic effect, and cases of temporary injury to eyesight of actors have been recorded. A committee operating under the Ministry of Health recently considered this matter very fully, and came to the conclusion that the liability to injury could be easily avoided if the sources were properly screened. Experts seem to agree that the use of very powerful unscreened lights is not necessary, except possibly in rare cases, in the kinema studio ; and that the most pleasing effects are obtained when the light is softened and diffused by reflection or transmission through translucent materials giving conditions approaching more nearly to daylight.

Arc-welding is another process where injury to the eye through ultra-violet light must be guarded against. In this case the richness in ultra-violet is due to the same cause—the mingling of metallic materials giving strong ultra-violet spectra, with the carbon. When a carbon arc is used to weld or cut iron plates the spectrum of iron, containing many prominent lines in the ultra-violet, is superimposed over the continuous spectrum of the glowing carbon. Operators must accordingly protect their eyes and skin by the use of goggles and masks.

So far as can be ascertained, the great majority of injuries that have been caused by ultra-violet energy are transient. The sufferer frequently feels no ill-effects at the time, but wakes up in the night to find his eyes in a most inflamed and painful condition. This passes off in due course. But it is conceivable that prolonged exposure to excess of ultra-violet light may have serious permanent effect. For example, cataract has been attributed to this cause, and it is a fact that albuminous transparent material can be almost instantaneously coagulated by exposure to these rays. An interesting research by Burge [1] leads to the suggestion that certain conditions of health, leading to an undue proportion of salts of calcium, magnesium, and sodium in the eye-lens, may accentuate the tendency of ultra-violet rays to cause cataract. This may explain why a few persons frequently exposed to these rays suffer, while the great majority escape.

It should not be assumed that ultra-violet light is necessarily prejudicial. In this case, as in many others, what is harmful when indiscriminately applied may be beneficial when used with discretion. Exposure of the body to ultra-violet light has proved of great value in the treatment of various skin diseases ; the rays which inflame the living tissue may kill a parasitic growth. Of the special sources used for this purpose, interest attaches to the mercury vapour lamp with a quartz glass tube, probably the richest of all artificial sources in ultra-violet light. Ladenburg has estimated that as much as 30 per cent. of the radiation of luminescent mercury is located in the ultra-violet light, and the quartz tube allows these rays to pass unimpeded. But in addition to these therapeutic uses, the exposure of the body to the ultra-violet energy derived from the sun is believed to be beneficial to the adult, while in the case of children it has a special value. Several infantile ailments are closely associated with access of light. Rickets is now regarded as a "disease of darkness." It was formerly thought that poor diet was the determining factor. Then it was found that the disease was contracted mainly by children in large towns who were little exposed to sunlight ; also that in some cities in India the children of the very poor who lived on an inferior diet but constantly played in the open air did not contract the disease, whereas the children of wealthy Hindoos who were well fed but lived an indoor, secluded life were very prone to it. Sir Henry Gauvain, in recently referring to these facts, mentioned that exposure to sunlight formed a regular feature of the treatment in the Treloar Cripples' Homes at Hayling Island, and it has recently been found that exposure to artificial sources rich in ultra-violet light can advantageously replace sunlight during unfavourable weather.

The Fading of Colours

Let us now turn to some effects of ultra-violet energy on inanimate things. One of the most striking effects due to this form of radiation is the fading of colours. The ultra-violet rays are potent in causing chemical action, of which photography has already been mentioned as a familiar example. The fading of objects when exposed to sunlight is well known. In certain cases, for instance in the case of priceless and unique specimens in museums, it forms a serious problem. Some interesting experiments on this point were recently summarised by Sir Sidney Harmer, Director of the Natural History Section of the British Museum, in a lecture before the Royal Society of Arts. In general natural colours are more permanent than artificial pigments. Artists have to be discriminating in their use of colours, for there are many pigments which fade appreciably after only a few days' exposure to strong sunlight ; an extreme instance of instability is to be found in the purple copying ink used on ordinary typewriter ribbons, which fades noticeably after a few hours' exposure, and ultimately may be made to disappear entirely. Even delicate natural

[1] *Electric World*, April 10, 1915.

colours, such as those in the wings of moths and butterflies, show distinct fading after some weeks of exposure, though the fur of some animals has been found to resist action for more than a year.

It is believed that the chemical action inducing fading of colours demands three chief conditions, the presence of ultra-violet light and oxygen and moisture. Thus if an object could be kept perfectly dry and enclosed in a vacuum, there should be no fading, but in practice this condition is rarely realisable. While it is probable that visible light may also play a subordinate part in causing fading of colour, it seems to be well established that the effect is mainly due to ultra-violet rays. Indeed, such sources as the quartz-tube mercury vapour lamp have proved of great value in enabling dyers and carpet manufacturers to test the permanency of their colour rapidly and scientifically, without being dependent on the capricious periods of sunshine characteristic of the British Isles. In the United States a special form of testing lamp for this purpose has been designed.

The most hopeful method of avoiding fading, therefore, is to exclude ultra-violet rays so far as possible. Sir Sidney Harmer has experimented with various glasses, more or less opaque to such radiation. Unfortunately the glasses that are most successful in this respect appear to have a distinct yellow coloration which would interfere with the observation of the colours of specimens—even if such glass could be used in sufficient quantities to enclose large objects. Another drawback is that the glass diminishes fading but does not eliminate it. The process is slowed down but is still cumulative, and the pitiless destructive force continues. Sir Sidney Harmer's experiments, however, suggest another interesting conclusion—that the "fading effect" of light from electric incandescent lamps is distinctly less than that of diffused daylight, and very considerably less than that of direct sunlight. It is worth consideration, therefore, whether objects having fugitive colours might be housed in rooms illuminated solely by artificial light—possibly by "artificial daylight" of the type described in the writer's former article, which would enable colours to be correctly revealed.

Other chemical effects of ultra-violet light have been applied for industrial purposes for the tanning of leather and in processes of sterilisation where the rays are designed to destroy injurious bacteria. But perhaps their most interesting effect is to be found in the phenomena generally described as "fluorescence," i.e. their conversion into visible light. By using an arc between tungsten electrodes, a quartz-tube mercury vapour lamp, or other source rich in ultra-violet rays, in conjunction with a plate of Chance's special glass, we can obtain ultra-violet light almost completely free from visible rays. This "dark beam" produced by a quartz lens is itself invisible. But when it falls on certain objects they exhibit "fluorescence" and themselves become luminous. Many substances have this property in a greater or lesser degree. Certain forms of zinc sulphide fluoresce with a vivid green, calcium sulphide with blue light; other materials can be found to give us red and other hues, so that it is possible to paint with them a picture, indistinguishable by visible rays, but glowing in natural colours when the ultra-violet energy is substituted.

Many crystals and precious gems have the same property. At a meeting of the Illuminating Engineering Society it was recently shown that by this means false stones could be distinguished from genuine ones, Indian pearls from the cultured Japanese variety, and South African diamonds from Brazilian ones. One

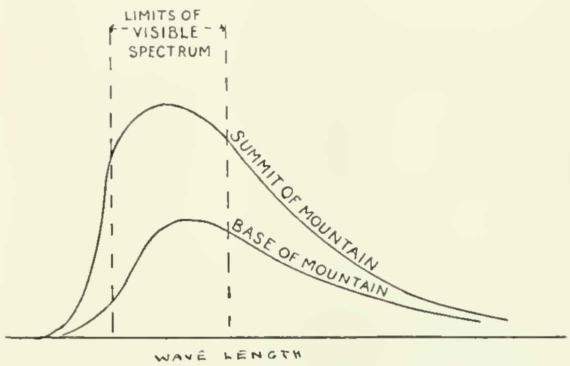

FIG. 2.—SHOWING THE DISTRIBUTION OF ENERGY IN SUNLIGHT AT THE BASE AND AT THE SUMMIT OF A MOUNTAIN 14,000 FT. HIGH.

(Based on Langley's experiments.)

Not only is the total radiation at the summit far greater, but the proportion of the ultra-violet is much increased, owing to the diminished absorption by the atmosphere.

can also prepare fluorescing solutions, and it has been suggested that by this means we could provide an additional safeguard in the preparation of bank-notes. They could be impregnated with fluorescing material leaving no traces in visible light, but showing a luminous pattern—a species of secret watermark—under the ultra-violet rays.

Fluorescence and Economical Lighting

Finally, it may be asked whether the phenomena of fluorescence could not be applied to produce a highly efficient luminous source yielding light without heat. The idea is of course familiar to scientists. A correspondent of DISCOVERY[1] draws attention to an extract from a work entitled *What is Electricity?* by John Trowbridge, published as far back as 1897, and mentioning some experiments of Ebert.[2] This investigator is quoted as having utilised an electric discharge in an exhausted glass globe, coated with fluorescent materials,

[1] Mr. C. G. Bishop. [2] *Ann. der Physik und Chemie*, No. 9, 1894.

mainly zinc sulphide. When a high-tension discharge was applied to the apparatus the zinc sulphide became luminous, doubtless owing to excitation by ultra-violet rays. This experiment is of historic interest (although Ebert's experiments would appear to have led to no practical development in this form of light-source) in view of the results stated to have been obtained by a French scientist, M. Risler. Of these experiments we must await further technical details. According to accounts published in the daily press Risler utilises a discharge through tubes (about 6 yards long) containing rarefied gases and coated with a fluorescent mixture having zinc sulphide as its main base. The combination is stated to have proved highly efficient.

Theoretically the production of a cold light in this way appears promising. But although the presumable absence of heat-radiation is a favourable factor, there are other difficulties. We have still to determine what proportion of the electrical energy applied to produce the discharge appears in a form to which the fluorescent material is responsive. Assuming that the efficiency in this respect is high, we have next to ascertain what candle-power is attainable from such materials when excited. Experience of ordinary phosphorescent phenomena does not suggest that a very powerful source of light could be obtained by this means. Phosphorescent and fluorescent effects, though striking when observed in a dark room, are usually of very feeble intensity in comparison with incandescent sources. The "ageing" and gradual failure of the material to respond to excitation would also need study. In addition phosphorescent materials almost invariably yield light of a peculiar colour—for example, a few vivid blue or green lines in the spectrum, which would not be very satisfactory for ordinary purposes of illumination, though possibly the difficulty might be overcome to some extent by a combination of materials.

Most experimenters with fluorescent substances would probably agree that there are formidable difficulties to be overcome in producing a commercial light-source based on this method. Nevertheless, this constitutes a fascinating line of investigation, and further details of Risler's experiments will be awaited with interest.

The First Book of Patents

By S. and J. Harrison

"Thirty-five thousand applications were granted in 1922," the blue-coated official who sits by the door of the Patent Office library in Chancery Lane informs the curious. If one is impelled by the information to discover how long mechanical invention has been a popular pastime, and what its beginnings were, the red file marked "Patents Nos. 1 to 40—1617–1627" provides entertaining reading.

The first three specifications in the file are not numbered, and the earliest of them was granted in February 1611. It reads as follows:

> Metallica; or the Treatise of Metallica Breafly comprehending the doctorine of Diuerse New Metallical Inuentions. But especially How to Neal, Malt, and work all kinde of Mettle, Oares, Irons, Steeles with sea-coale, pit-coale, earth-coale and Brush Fewell. also a Transcript of His Maiesties letters patent of priuledge, Granted unto Simon Sturteuant for the said Metallical business for one & thirty years.

This patent, like all the early ones, was, in its way, quite a literary work. It was not written in the terse, technical language which the patent-agent uses in the drawing-up of a modern specification. Classical allusions and Biblical quotations were frequent. There were occasional references to the Saints. Simon Sturtevant, for instance, starts his specification thus:

> Gentle Reader, I am not ignorant how they that are willing to apprehend and assist new buisness are desirous to be satisfied on these points. First concerning the perfect and exact knowledge of the inuention wherein they are to deal and negociate, for as the common prouerbe saith:—"Ignoti nulla cupido." . . .

Mr. Sturtevant, however, must have got into trouble, as the next patent shows.

> But not that which was published by Mr. Simon Sturteuant upon his Patent, which is now, by order, cancelled and made voyd, by reason of his standing out-lawed at the time of the grant, and so still continuing and his neglect and not performance of the workes. Whereupon Priuledge By Patent is granted by the King's most excellent Megesty to John Rovenson Esqr., for the making of iron and other materials with sea-coale, pit-coale &c., for one and thirty years. . . .

The third volume in the file, and the first to receive a number, was granted in 1617 to Avon Rathburne and Roger Burges "for a terme of twentie and one years" by "James—by the grace of God Kinge of Englande, Scotland, Fraunce and Irelande." Although the words "Englande" and "Irelande" are each here spelt with a terminal "e" they are written modern fashion during the course of the specification itself. The patent was concerned with the printing of maps and plans, and the following quotation shows the patentees to be full of a pride of city.

> . . . to the great honor and renowne of those princes in whose domynions they are, and that our cittie of London, being chiefe and principall in this our Kingdome of England there hath never been made or taken any true or perfecte descripcon, but false and meane drought cutt out in wood, and soe dispersed abroade, to the great disparagement and disgrace of soe famous and worthie a state :

The closing of a sentence with a colon is only one of the more obvious curiosities of punctuation to be found in these early patent specifications.

In the same year, John Jasper Wolfen and John Miller were granted a patent (No. 4) for protecting armour and arms from "rust or canker."

> A certayne oyle or composicon of oyles wherewith to keepe Armors and Armes from Rust, Canker or the like Meanes of perishing or decay farre exceedinge the ordinary wayes or Meanes nowe or heretofore Vsed in that behalfe :

This patent, it seems, could more fairly be described as a wide monopoly, for not only are the terms delightfully vague, but the patentees could collect 40s. on each quart of oil used that infringed their rights. They were legally entitled to search any premises suspected of harbouring such oil, provided that they were accompanied by a constable. And all these rights cost only 40s. per year. It seems that the two Johns are the spiritual fathers of the panacea mongers who infest commerce to-day. They made their claims but said nothing concerning the composition of their product.

John Jasper Wolfen did, however, patent an invention later on (No. 40), which, though last of the patents in the file, is far from being the least important. It refers to :

> . . . a Newe invencon for the making and pparing of ctaine Stuff and Skynns to hould out Wette and Rayne. . . .

In the specification of what is probably the father of the raincoat appear these words :

> . . . a commodity which he affirmeth is very likely to be of verie good vse and benefitt to the comonwelth. . . .

Wolfen must surely have had a grievance against "Wette and Rayne."

Another gentleman whose thoughts took the same line was one William Bale, "Gouldsmith of London" (No. 32). He patented

> . . . certen compounded stuffs and waters called or known by the Name of Cement or Dressing for Shippes. to preserven them from being burned owing to a fight at sea allso to protect their hulls from Sea-worme and Barneacle. . . .

We are still looking, in 1923, for the perfect anti-fouling dressing for ships' hulls. Patent No. 5 is of interest for the following naïve personal reference which it contains :

> . . . to Thomas Murraye Esquire, secretarie to our deare sonne Prince Charles. . . .

The first truly mechanical invention—if one excepts an invention for raising water and ploughing land without oxen or horses (the patentees do not say how !)—was patented by John Dickson (No. 16—1619). It was a "Backstall or Back frame" for bedridden invalids. The specification informs us that Mr. Dickson noticed that persons who lie in bed for any length of time are liable to suffer from "distemper." The invention was presumed to overcome this.

Only one other really important invention is to be found in this file. It was granted to Edward Knappe in 1625 (No. 31). He patented a most revolutionary type of coach and harness. The vehicle was to have a variable track, so that the wheels could be set apart at the distance most suitable to whatever road was being traversed. Even if Knappe had refrained from making any reference to the vile surfaces of some of the roads of his day, the mere existence of the patent is surely sufficient testimony to their condition. The body of Knappe's coach was slung between springs, and possessed an apparatus whereby the driver could stop the rear wheels from rotating without leaving his seat. The inventor made wide claims for his vehicle, but when one considers that this may have been the first design including both springing and a proper braking system, they do not seem to be unduly exaggerated.

Two thoughts arise when one has finished reading the red file. Firstly, why is it that modern manufacturers do not name any of their models after those obscure inventors who, maybe, are the true founders of their several industries ? And, secondly, what would Knappe, Wolfen, and the others think of tanks and submarines, of aeroplanes and wireless ?

Curiosities of Science

Twice a year the Royal Society holds what are known, rather quaintly, as Conversaziones. On these occasions distinguished workers in many varied fields attend to give demonstrations of some striking example of their recent discoveries or inventions, for the benefit of the inexpert.

At the Conversazione held on May 16 at Burlington House there were in all thirty-seven different exhibits. They were for the most part admirably selected—and the selection of a subject capable of simple demonstration,

and at the same time of striking interest, is not by any means a simple matter. For instance, a very large instrument for estimating the heating powers of gas—"The 'Boys' Integrating and Recording Gas Calorimeter"—while fascinating in its intricacy, was perhaps of too complicated design to be understood save by the expert, after careful study.

Great interest was taken in a "stream-line filter" exhibited by Dr. Hele-Shaw, F.R.S. Everyone is familiar with the waste of time involved in filtering fluids containing suspended matter by ordinary means. Yet filtration is a process which is essential every moment in laboratories. In this new filter, a most simple device is employed with extraordinary success. Holes about half an inch in diameter are punched through a series of sheets of paper—the eventual effect being rather as if one had pushed a cheese scoop through a magazine several times. The dirty water is then forced through these holes by a pump, while the sheets of paper are forced together with a variable strength. The water is only allowed to escape between the leaves of paper, and since that space is exceedingly small, all solid matter remains behind in the large punched-out spaces. Even a dye, such as methylene blue, if put through the filter, comes out colourless, and it must be remarked that this is in no sense the effect of what is called "adsorption"—a physico-chemical process by which a kind of combination between dye and paper takes place—but a true filtration, or mechanical removal of suspended matter.

Mr. John Walton, of the Botany School, Cambridge, also selected a simple and yet most interesting demonstration. Fossil plants, while common enough, are rather disappointing to the botanist, since they show little detail. In Mr. Walton's new method of examination, an impression of the fossil is taken on a gum known as balsam. The rock is then dissolved off with acid. The results are amazing. Every tiny detail of hairs, cells, and water-conduction systems of the leaves is revealed with absolute clearness, and, instead of a faint impression on a rock, we are face to face with what appears to be a living plant, which grew and faded away many million years ago.

Mr. Walter Heape, F.R.S., showed a series of photographs, taken at the rate of from 500 to 5,000 per second. The breaking of a glass vacuum-tube by a hammer was one example—the complete break-up taking only a twentieth part of a second. The tube seemed to bulge inward first at the point of impact, and then the part of the tube opposite to that point bulged outwards, and broke in a fine powder; finally the process of destruction extended all over the tube. A solid rubber ball was also followed in its course from a gun to a steel target—a process which, with the rebound, occupied only one-fortieth of a second. It assumed the most complicated shapes during its adventures—varying from a flat disk, when it hit the target, to an egg with a flat base when it bounced off. Intense illumination is essential for these experiments—two searchlights were employed in one instance—and the cinema machine was an immense erection, operated by electricity.

Much has been heard of late concerning the transplantation of the heads of water-beetles. Three specimens of beetles thus treated were shown by Mr. H. Graham Cannon—of the beetle *Hydrophilus* on which the head of a separate species, *Dytiscus*, had been grafted. In one case a dissection had been made, and it was shown that the gullet of the composite creature which resulted was continuous throughout. The further developments of this new investigation will be awaited with great interest. Skin grafting, bone grafting, and gland grafting have been performed for many years with success; but when we remember that a successful grafting of a head on to a new body involves the regeneration of nervous tissue—or at least appears to involve it—we are in touch with a really important question. It is well known that, in the human body at all events, if the spinal column is cut across there is never any regeneration. A nerve, on the other hand, will regenerate, although, as far as we know, there has never been a successful attempt to graft a nerve from another species on to a severed nerve.

A more intimate exhibit was that of the contents of a crocodile's stomach, which was, in the words of the catalogue, "a notorious man-eater." It lived in Africa, in the Tanganyika Territory, and its stomach contained a number of human bones, several metal bracelets, a bead necklace, and the quills of a porcupine. There must be several disadvantages in being a crocodile!

The National Institute of Industrial Psychology, under Dr. S. C. Myers, F.R.S., showed a number of examples of research work. There were investigations on the effect of improved illumination on the output of coal-miners, and a series of tests which were designed to select individuals entering engineering trades for their most appropriate tasks. They consisted of strips of wood of various sizes, which had to be grouped in pairs so as to make strips of equal length, geometrical figures which together made rectangles, and other more complicated devices. The results of these tests were in many cases surprising and valuable; for example, it is seen that there is never any relationship between accuracy of muscular control and muscular strength; moreover, the particular aptitudes discovered were independent of the general intelligence of candidates as tested by an examination in English.

Our only regret is that such demonstrations as this of the Royal Society are not open, more frequently, to the general public. They go a long way towards stimulating interest in the great advances of the present day.

R. J. V. Pulvertaft.

Reviews of Books

The Nebular Hypothesis and Modern Cosmogony. By J. H. Jeans, M.A., F.R.S. (Oxford: Clarendon Press, *2s. 6d.*)

Those of us who read seldom give the attention to lectures issued as pamphlets that is given to larger works bound in cloth. This is frequently a mistake. A lecturer with an audience to face, and a subject to describe

in a limited time, must necessarily put more of himself into his lecture than he would if he were merely expanding his ideas in the quiet of his study. For a lecture he must choose the right facts and ideas germane to his theme very carefully, describe things clearly, omit cumbersome details, avoid side-issues, and make the whole as plain and interesting as possible. These are precisely what the general reader likes a writer to do.

Dr. Jean's Halley Lecture is a case in point. It is an excellent example of semi-popular exposition. He gives an account of Laplace's nebular hypothesis, shows that it will not explain, as Laplace hoped it might do, the origin of our solar system, but that with a little modification it explains very satisfactorily the birth of stars from a nebula of hot rotating gas. Much of the lecture is concerned with this point. In the second part the lecturer discusses the formation of our solar system. Planets, he shows, are not evolved from a star as the star has evolved from a nebula. They are probably produced as the result of one star passing in its course sufficiently near to another permanently to affect it. Calculation shows that violent disturbance of this kind will be the lot of very few. In consequence systems such as the solar system " must be rare in the sky . they may be normal in the sense that the events which formed the planets out of our sun might have happened to any star ; but they are abnormal in the sense that such events have in all probability happened only to very few. Indeed, it is just within the bounds of possibility, although quite, I think, outside the bounds of probability, that our system is unique—that out of the two or three thousand million stars which people space, our sun may be the only one attended by satellites. To carry this train of thought one step farther, it is just possible, although again quite improbable, that our earth may be the only body in the whole universe which is capable of supporting life."

That is surely a highly interesting statement from modern science. And later Dr. Jeans expresses this thought in a different way. " We begin to suspect that life is not the normal accompaniment of a sun, since planets capable of sustaining life are not the normal accompaniment of suns. Astronomy . . . begins to whisper that [life] must necessarily be somewhat rare. Her suggestions, although still vague, seem to indicate that our terrestrial life forms a greater proportion of the sum total of all the life of the universe than we at one time thought."

Botany of the Living Plant. By PROF. BOWER, Sc.D., F.R.S. Second Edition. (Macmillan & Co., 25*s.* net.)

Professor Bower's textbook, " framed on the lines of the annual course of Elementary Lectures on Botany given in Glasgow University for more than twenty years," was first published in 1919. The author is recognised as one of the leading authorities on that branch of Botany which is more especially concerned with the form and structure of plants ; by his intensive study of the ferns and allied plants he has done more than any of his contemporaries to provide trustworthy data which throw light on the relationships of certain families and on their relative position in the order of evolution. In his book, as one would expect, he has given an attractive picture of the plant kingdom from the standpoint of a botanist who thinks of a plant as a complex machine fitted by its structure for the manifold activities of a living organism. In the first edition it was thought by some reviewers that too little attention had been paid to the cell as the unit of plant structure. The living protoplasm of the cells is the seat of the innumerable chemical-physical phenomena which form the basis of life, and it is of the utmost importance that students should realise at an early stage in their career that a knowledge of the properties of the cell-contents is the first step towards an intelligent appreciation of the mechanism of plant life. The addition of a chapter on the living cell has added considerably to the value of the book. Other alterations are also improvements. The addition of a chapter on Evolution, Homology, and other subjects of fundamental importance draws attention to conceptions which are liable to be neglected in a book primarily concerned with supplying the raw material of botanical facts. It is clearly impossible, even within the limits of a bulky volume, to deal thoroughly with the different divisions of the plant-kingdom from the dual point of view of structure and function. Every teacher knows that one of his greatest difficulties is to decide what to omit. A course on elementary botany is merely an introduction ; the aim should be to illustrate fundamental principles, to enable a student to grasp essentials, and to awaken his interest in plants as living things. Professor Bower's treatment of the subject is both scholarly and interesting ; he is careful of detail and does not lose sight of its application to the major problems with which the biologist is concerned. In a general textbook for elementary students it is perhaps superfluous to include an account of many families of flowering plants, as the author has done in Appendix A. The important point is to give a student a general idea of the nature of a flower, to enable him to appreciate the range of floral structure within a family, and so to understand the meaning of a natural system of classification, and to teach him how to use a Flora in order that he may identify plants in the field. The more detailed systematic treatment of families of flowering plants is provided for in various books devoted to that branch of botany.

A. C. S.

A Perthshire Naturalist : Charles Macintosh of Inver. By HENRY COATES, F.S.A. Scot. Foreword by PROF. J. ARTHUR THOMSON and PROF. PATRICK GEDDES. (T. Fisher Unwin, Ltd., 18*s.*)

Mr. Coates describes the life-story of a poor but very remarkable Scotsman—rural postman, naturalist, and musician—who died at the age of eighty-two at the beginning of last year. Macintosh was the first-born of a hand-loom weaver—one of the kind you read about in Barrie's *Window in Thrums.* He tried saw-milling on leaving school, but an accident that maimed his left hand when he was nineteen led him to become a postman. His beat lay in the particularly charming countryside around his native village, Inver, a tiny place across the

Tay from Dunkeld in Perthshire. He held this post at a salary of less than forty pounds a year till he was fifty-one, when he retired on a pension of ten shillings a week. He did not marry upon either of these incomes. He was early imbued with a love of nature, and his calling and the countryside gave him excellent opportunities of using his talents. He was a bit of an ornithologist, a biologist, a meteorologist, and an archæologist; but most distinguished as a botanist. On these subjects he published no less than ten papers in the *Proceedings of the Perthshire Society of Natural Science.* He was particularly keen on fungi, and of the seventeen he discovered, four were new to science, and the remainder to Britain.

He was also interested in music. He collected old melodies, composed a few new ones, tried his skill at hymn-tunes, and, despite his maimed hand, could perform on the 'cello. "Fond of living things, perhaps birds and children most of all, of music and poetry, of wood-turning, of old things, of queer things like toadstools, of his microscope, and of the march of the seasons, he never had a dull moment. Of course, he made his discoveries of new creatures and new occurrences, of which anyone might be proud, but the man was bigger than all he did. . . ."

This I quote from the foreword. He was indeed a fine type of naturalist who made a success of his life in the true sense.

The book is, however, more than a mere biography of Macintosh. The opening chapters are taken up with a sketch of the topographical features and the past history of the region where his life was spent, and they throw light on the part which central Perthshire played in the history of Scotland. Next, the folk-lore of rural Scotland during the eighteenth and nineteenth centuries is dealt with, and many half-forgotten customs and incidents are recalled. The chapters which mainly record the results of Macintosh's researches give at the same time an interesting epitome of the folk-music and the natural history of Perthshire.

This is a book for Scots, for lovers of Nature, and for those who, like Edward Fitzgerald, realise that in the biographies of obscure persons there is more of interest than in any but the very finest novels.

The Spectroscope, and its Uses in General Analytical Chemistry. By T. THORNE BAKER, A.M.I.E.E., F.R.P.S. Second Edition. Pp. x + 208; 94 figures. (London: Baillière, Tindall & Cox, 1923, 8*s.* 6*d.* net.)

Mr. Thorne Baker has aimed at producing "an intermediate textbook which will connect the ordinary treatises on general physics with the modern advanced works on the spectroscope," but has only succeeded in writing a somewhat discursive survey of the various fields covered by modern spectroscopy, suited rather to the amateur than to the student. In spite of the sub-title, the analytical use of the spectroscope is not well described, and the practical instructions given are frequently inadequate. The theoretical discussions are elementary and not always lucid. Good features of the book are the illustrated descriptions of laboratory spectroscopes commercially obtainable, the sections on the choice and use of plates for spectro-photography, and the inclusion of many references to the original literature.

D. C. H.

[N.B.—Owing to a publishers' error, the price of this book was originally given as 7*s.* 6*d.*]

Some Questions of Phonetic Theory. Chapter VI. The Mechanism of the Cochlea. By WILFRID PERRETT, Reader in German in the University of London. (W. Heffer & Sons, Ltd., 2*s.*)

This little book is controversial and acutely technical. It attacks the theory of "sympathetic resonance" in the cochlea—the idea that those of us who hear have a kind of "baby grand" in either ear. In its irony and witty asides the book is more akin in style to a dialectic display in the *Classical Review* than to the duller but no less pertinent arguing in a magazine like *Nature.*

The Religion of Science. By WILLIAM HAMILTON WOOD. (Macmillan & Co., Ltd., 6*s.*)

It is difficult to understand for which class the professor of Biblical History at Dartmouth College, New Hampshire, has written this book. Theologians may agree that the science disclosed in it is all right, but they will never pass the theology, and biologists, without disputing the theology, will smile at the author's statements about evolution. The plain reader will be completely mystified by the quantity of miscellaneous information conveyed to him. The style, moreover, is both too allusive and too elusive. No, I am afraid this book will not do.

The Mathematical Theory of Relativity. By A. KOPFF, Professor of Astronomy at the University of Heidelberg. Translated by H. LEVY, M.A., D.Sc. (Methuen & Co., 8*s.* 6*d.*)

This book contains a clear exposition of the mathematical and physical foundations of Einstein's theory in the form of a course suitable for University students of mathematics and physics.

The Problem of Solution. A Tavern Talk between certain Chymists and Others. By STEPHEN MIALL. (Benn Brothers, 2*s.*)

This quaint, amusing, and, on the whole, good-natured pamphlet describes a conversation in the style of two hundred years ago on the subject of solution in chemistry between a Friend (representing the majority of chemists at the present day who believe in "ionisation") and a Chymist (the Armstrong school which believes that part of the theory is untrue and other parts positively disproved). Friend is not entirely worsted, but he receives many knocks from Chymist, a tremendous talker, who is clearly out to win a dialectic triumph, and who is the type of arguer which makes reference to Mr. Dooley.

A student of chemistry will gain much interest in, and some information about, the facts of solution from this talk. It has an introduction by Professor H. E. Armstrong and it is followed by several critical letters.

Says Chymist: "I think the explanation these ionists give of solution, of electrolysis, of osmotic pressure and of chymical change is misleading and doing great harm

to the young students. Some day all these ideas and the jargon in which they are expressed will be out of date as the doctrine of phlogiston. That was a useful idea for a few years; it made people think." But with regard to the second sentence, how can Chymist or anyone else say that? The future *may* decide in favour of the theory of ionisation, and regard as very trivial indeed present objections to it. But who can say? Someone who argues very like Chymist attacked the disintegration theory of radio-activity twenty years ago. The theory stands now as it did then, but where are now the objections? It is they that lie on the dust-heap where "the elixir of life" lies dead and "phlogiston" rots.

The Phase-Rule and its Applications. By Alexander Findlay, M.A., D.Sc., F.I.C. (Longmans, Green & Co., 10*s.* 6*d.*)

The fifth edition of this excellent work, the most popular among students of Sir William Ramsay's series of *Textbooks of Physical Chemistry*, includes the notable additions to the subject since the time of the last edition, 1914. These are principally in connection with heterogeneous equilibria. In consequence there has been much revision and addition. The sections on sulphur and phosphorus, for example, have been rewritten, and that on iron-carbon alloys has been drastically revised in the light of recent work. Graphical methods of representation, especially those suggested by Jänecke, have been expounded more fully here than in the earlier editions. And in other ways there are improvements which add to the usefulness of the book.

Maps and Survey. By Arthur R. Hinks, C.B.E., M.A., F.R.S. Second Edition. (Cambridge University Press, 12*s.* 6*d.*)

Maps and Survey, by the Secretary of the Royal Geographical Society, first appeared in 1913, when the author lectured in the department of Geography at Cambridge. The titles of its chapters then were Maps, Map Analysis, Route Traversing, Simple Land Survey, Compass and Plane Table Sketching, Topographical Survey, Geodetic Survey, and Survey Instruments. The book is now reissued with the original chapters as they stand supplemented with one containing a few necessary corrections and additions. To these have been added new chapters—A Further Chapter on Maps, Maps and Survey in War, and New Methods of Survey—so that the work might include a description of the very valuable advances made during the years of war, and be up-to-date.

The book is now one which students of geography may read for accurate information on the subject it describes. It is clear and comprehensive; the author is and has been in a position to obtain up-to-date information, and he is one who loves accuracy and carefulness of statement for their own sakes. The first of the new chapters describes matters recently under discussion at the Geographical Society, such as the international map on the scale one to a million, flying maps, and the spelling of place-names; the second gives an account of the work of "Maps" during the war—survey for artillery, flash-spotting, sound-ranging, etc.; and the third subjects like mapping from air photographs, and instruments for stereoscopic survey.

A Textbook of Ore Dressing. By S. J. Truscott, A.R.S.M., M.I.M.M. (Macmillan & Co., Ltd., 40*s.*)

An informed, comprehensive, and well-illustrated treatise on the subject by the professor of mining at the Imperial College of Science and Technology, the more valuable and useful because the author in his day has been a practical man. The dedication (in the first nine words of the Absolution in the Prayer Book) might, one reader at least thinks, have been expressed differently, or, better, since the book is on technology, omitted altogether.

Chemical Technology and Analysis of Oils, Fats, and Waxes. Vol. III. By Dr. J. Lewkowitsch, M.A., F.I.C. Sixth Edition. Revised by George H. Warburton. (Macmillan & Co., Ltd., 36*s.*)

This volume completes the revised edition of Dr. Lewkowitsch's standard work of reference on the subject, and contains chapters on the technology of manufactured oils, fats, and waxes, and on the technology of waste oils, fats, and waxes, and the commercial products derived from them.

Books Received

(Mention in this column does not preclude a review.)

ANTHROPOLOGY AND ARCHÆOLOGY

The Ancient Egyptians and the Origin of Civilisation. By Prof. G. Elliot Smith, M.A., M.D., Litt.D., F.R.S. New and Revised Edition. (London and New York: Harper & Bros., 6*s.*)

The Bakitara or Banyero. By John Roscoe. (Cambridge: at the University Press, 25*s.*)

SCIENCE

Aspects of Science. By J. W. N. Sullivan. (Richard Cobden-Sanderson, 6*s.*)

Great and Small Things. By Sir Ray Lankester, K.C.B., F.R.S. (Methuen & Co., Ltd., 7*s.* 6*d.*)

Electrons, Electric Waves, and Wireless Telephony. By J. A. Fleming, M.A., D.Sc., F.R.S. (The Wireless Press, Ltd., 7*s.* 6*d.*)

The Radio Experimenter's Handbook. By Philip R. Coursey, B.Sc. Part II. (The Wireless Press, Ltd., 3*s.* 6*d.*)

How to build Amateur Valve Stations. By P. R. Coursey, B.Sc. (The Wireless Press, 3*s.* 6*d.*)

Special Steels. By Thos. H. Burnham, B.Sc. (Sir Isaac Pitman & Sons, Ltd., 5*s.* net.)

Plant and Flower Forms. By E. J. G. Kirkwood. (Sidgwick & Jackson, Ltd., 7*s.* 6*d.*)

Interfacial Forces and Phenomena in Physiology. By Sir William M. Bayliss. (Methuen & Co., 7*s.* 6*d.*)

Advanced Practical Physics for Students. By B. L. Worsnop and H. J. Flint. (Methuen & Co., 21*s.*)

British Plant Names and their Derivations. By R. J. Harvey-Gibson, C.B.E., D.Sc. (A. & C. Black, Ltd., *2s. 6d.*)

The Works of Aristotle. Translated into English Meteoralogica. (Oxford : at the Clarendon Press, *7s. 6d.*)

On the Existence of a Hitherto Unrecognised Factor Essential for Reproduction. By Herbert M. Evans and K. Scott Bishop. (Reprint from *Science*, vol. lxi.)

Alternating-current Electrical Engineering. By M. T. Maccall. (University Tutorial Press, Ltd., *15s.*)

PSYCHOLOGY

Character and the Unconscious. A critical exposition of the psychology of Freud and Jung. By J. H. Van der Hoop. An authorised translation by Elizabeth Trevelyan. (Kegan Paul, *10s. 6d.*)

A Study of American Intelligence. By Carl C. Brigham, Ph.D. A foreword by Robert H. Yerkes, Ph.D. (Humphrey Milford, Oxford University Press, *16s.*)

Heredity and Child Culture. By Henry Dwight Chapin, M.D. (Routledge, *6s.*)

MISCELLANEOUS

The Elephant Man, and Other Reminiscences. By Sir Frederick Treves, Bart., G.C.V.O., etc. (Cassell & Co., Ltd., *7s. 6d.*)

Below the Snow Line. By Douglas W. Freshfield, D.C.L. (Constable & Co., Ltd., *18s.*)

The Railroad Picture-book. Pictogram No. 1. (The Pictogram Co., Washington, D.C., 25 cents.)

The Oldest Letters in the World—Tell us What? By Mrs. Sidney Bristowe. (George Allen & Unwin, *5s.*)

Correspondence

To the Editor of Discovery

Dear Sir,

Professor Mawer, in his article on "Some Types of English Place-names," in the April number of Discovery, gives the element *ea* as meaning stream or river. Years ago I was living on the edge of the fen district ; and during my travels across the fens, I found a series of names containing the *ea* element, i.e. Eastrea, Oldeamere, Waldersea, Stonea, and Manea.

I was told that the *ea* element of these names meant *island.*

I should be much obliged if Professor Mawer would inform me if in the fen district it has this interpretation, or whether I have been misinformed.

I should also be pleased if he would enlighten me whether or not the originals of Ramsey, Whittlesey, and Thorney, were Ramsea, Whittlesea, and Thornea.

I am, yours truly,

Albert R. Thornewell.

Fir Tree House,
Mucklow Hill,
Hales Owen.
April 11, 1923.

[Professor Mawer has been kind enough to send us the following solution of the problems raised by our correspondent.—Ed.]

In the case of *Eastrea*, Professor Skeat, in the *Place-names of Cambridgeshire*, gives the early form *Estrey.* He mentions *Stonea* and *Manea* and suggests that they once had the suffix *ey*, but he could give no early form. Confirmation of his view is to be found, however, in a form *Maneye* in an Inquisition of Edward I. He further gives early forms of *Anglesea*, *Horningsea*, and *Whittlesea* (which he spells thus) in *eye*, and there is no doubt that he is correct in stating that in all these names we have the regular M.E. development of Old English *eg*, "island," and not a form derived from O.E. *ea*, "river."

Exactly how the peculiar change from the normal *-ey* to the modern and irregular *-ea* arose it is difficult to say, but the suggestion may be made that in names like *Whittle-sey*, *Ram-sey*, *Horning-sey*, the presence of the *s* in the middle of the name led to a piece of folk-etymologising whereby the words were divided as suggested by the hyphen above inserted, the idea being that the suffix was really the word *sea*, meaning "lake," and referring to the neighbouring mere or fen. When once this idea arose the spelling with final *ea* would soon be introduced to confirm the idea. Later that spelling was extended by analogy to other names like *Eastrea*, *Manea*, *Stonea*, which had no medial *s*. *Ramsey* and *Thorney* are also *ey* names and were never, so far as the evidence goes, even spelled with final *ea*. A. M.

To the Editor of Discovery

Dear Sir,

In a letter of July 19, 1921, of your issue I note that the reason or purpose of the prehistoric cup-markings is not understood.

Whenever I have come across them in India (they are fairly common), it always struck me that such depressions in stones were produced by abrasion in pounding grain. Only once I came across people actually pounding their grain in these holes. Ordinarily they use a stone mortar and pestle, the hole getting enlarged by use.

It will probably be found that in erecting dolmens they used the slabs in which grain had been pounded. The more stone abraded away, the easier to erect, and the cup depressions were a guarantee of strength of the material.

Saucer-like depressions in stone occur all over India where there is gold : and it is worth noting that the ancients never ground their ore in stone of the same species out of which the gold had been extracted. For instance, the grinding stones on the Kolar Gold Field are always of granite or gneiss, and this rock lies away from the old workings for gold. They used dolerite, and they probably knew gold never was found in that rock.

Louis Stromeyer.

Coromandel P.O.,
K.G. Field,
Mysore State, S. India.
February 27, 1923.

DISCOVERY

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Binding cases for Vol. III, 1922, are now ready. Price 2*s.* 6*d.* net each; postage, 9*d.*

Editorial Notes

It was reported in a local paper a few weeks ago that the "Tut craze" had vanished into thin air and that a Hebrew merchant, interviewed in a "curiosity" shop, wrung his hands as he pointed to a heap of Egyptian dresses and odds and ends of furniture, carved in Oriental style, in a corner, remarking, "Look at all that junk there; all interest in the Luxor discoveries has disappeared, and that stuff is absolutely valueless." We hasten to assure the sad merchant that the "Tut craze" will be revived this autumn when Mr. Howard Carter resumes work on the Pharaoh's tomb. The chief interest in the further investigations will be focused on the opening of the dead monarch's sarcophagus. If this reveals the mummy, which in all likelihood it will do, an X-ray examination will be made. In this event a further sentimental campaign against desecration will probably force its way into the pages of the daily press. We should like in as few words as possible to emphasise what we consider to be the right attitude towards this idea of desecration.

* * * * *

In the first place Tutankhamon's mummy will almost certainly be restored to its sarcophagus after X-ray examination. The only motive which would urge Mr. Howard Carter to remove it to the Cairo Museum would be a consideration for its greater safety. In our February issue Dr. Blackman wrote an article on the Plundering of the Royal Tombs at Thebes in the Twentieth and Twenty-first Dynasties. Of these ravages we have definite documentary evidence which was admirably summarised by Dr. Blackman. But it was not merely at this period, but much earlier and, indeed, ever since that the inhabitants of the district round Luxor have plied a thriving trade in despoiling the tombs of their furniture and often even in cutting up the mummies and selling the pieces. As Professor Elliot Smith reminds us in a recently published book,[1] Sir Thomas Browne wrote two and a half centuries ago that "the Egyptian mummies which Cambyses or time hath spared, avarice now consumeth. Mummy is become merchandise, Mizraim cures wounds, and Pharaoh is sold for balsams." Thieves abound in Egypt to-day in all "tomb" localities, as anyone who has visited Egypt and interested himself in its archæology will testify; and when they probe into a tomb not touched by an Egyptologist, little is left of the things inside and even the mural paintings are chipped out of the walls. Under the circumstances two alternatives can be adopted in the case of Tutankhamon's mummy: if it is left to repose in its original resting-place, then it will have to be continually and rigidly guarded; if it is not so guarded, it had better be removed to Cairo. So numerous have been the ravages in the past that the only royal mummy hitherto found in its own tomb was that of the Pharaoh, Amenhotep II. In the case of this discovery, the first alternative was adopted, and it was adopted by none other than Mr. Howard Carter, at that time the Inspector of Antiquities at Luxor.

* * * * *

Any objections raised to the examination of the body by X-rays are foolish. No harm can be inflicted upon it by such an examination, as Professor Elliot Smith and other authorities have pointed out. But, on the other hand, a great amount of valuable information will be so gained about the physical qualities and diseases of the inhabitants of Egypt living nearly

[1] *Tutankhamon and the Discovery of his Tomb.* By Prof. G. Elliot Smith, F.R.S., etc. (Routledge, 4*s.* 6*d.*)

3,500 years ago and of the methods of embalming in use at the time.

* * * * *

A subject which no serious-minded man can neglect to-day is that of research into what are known as Psychical phenomena. There are few people who are entirely convinced that every incident in life, and especially in the relationships between human beings, can be satisfactorily explained by known and established physical laws. For example, there appear to be undoubted cases of what is known as Telepathy. The parlour-game trick of selecting five playing cards, grasping the hand of another person who keeps his eyes shut, and bidding him choose a selected card from the five, succeeds far more often than is accounted for by the laws of chance. There are, of course, possibilities of error; for example, slight involuntary movements may direct the hand. Apart from this particular case, most people can recall a personal experience where there appears at first sight, whatever be the truth, to be an intuition concerning the doings or fate of an intimate friend at a distance. The investigation of any experience of this sort is manifestly a matter of intense difficulty. Coincidence can rarely be excluded; self-deception and wilful deception must be considered before any other explanation of seemingly mysterious happenings. It does not seem at all impossible, however, that man should possess either some traces of a power of receiving communications otherwise than through the recognised channels, or should slowly be evolving that power through the intimate social relationships imposed by his communal organisation. But the fact that a great number of curious little experiments and inexplicable happenings deserve further inquiry does not call for an immediate abandonment of all simple explanations of such things.

* * * * *

In this connection we would like to refer to an article in that excellent quarterly review of psychology, *Psyche*, for April 1923, with which some of our readers will be familiar. The article in question is called *Convincing Phenomena at Munich*. A few quotations will show what these phenomena were. A medium, known as "Willy," was provided by Baron von Schrenck-Notzing, in whose private house the mysterious happenings occurred. It should be mentioned that a previous series of queer events had taken place in the Baron's presence with a medium known as Eva. It is surely natural to expect, therefore, that the individual who was present on both occasions, namely the Baron, should have been particularly investigated. However, the company devoted their attention to Willy, who was dressed in tights, and whose hands were both held. The hands of the rest of the company were also clasped —all save the Baron's, one of whose hands was free. In almost complete darkness things began to happen. "A small table (on which was placed a luminous rectangular card and a luminous bracelet) was placed on a larger table in front of a large cabinet. After the medium became entranced the card was moved, the bracelet was waved in the air, the table was knocked over. These same phenomena occurred again after an interval of a minute or two, the smaller table being passed, with one pause, completely round the larger one."

* * * * *

The writer, Mr. H. Price, goes on to note that this pause would be accounted for if the table had been moved by a human being with one hand only. And still no one seems to have thought of the Baron's other hand! We preserve as open a mind as possible concerning the value of these examples of "Levitation." But we would like to see, as a first preliminary to establishing the super-normal nature of these rather trivial little adventures of domestic furniture, the Baron attired in tights, with both his hands grasped. It would appear, to a casual observer, that the attention directed to Willy recalls the exhortations of the conjurer to "Watch my right hand" while his left is busy somewhere in the background. And even if all the precautions of which we could think proved futile to restrain the Baron's belongings from inordinate activity, we cannot help admitting that the frankly engineered mysteries of Maskelyne and Devant in broad daylight fill us with far more superstitious awe than musical-boxes that obey the word of command, and slowly rising handkerchiefs.

* * * * *

Those whose good fortune takes them to the South Downs of England will have noticed, as one of their outstanding features, the barrows and grassy earthworks which crown many of the heights. They are referred to in Kipling's Sussex poem:

> "What sign of those that fought and died
> At shift of sword and sword?
> The barrow and the camp abide,
> The sunlight and the sward."

Many will have wondered what these remains signify —how ancient they are, and what manner of person built them. A novel and, it would appear, most important method of investigating these questions is by means of air photographs. Mr. O. G. S. Crawford, who during the war took many such photographs over enemy ground, has been inspired to use this means of surveying wide stretches of downland. He has described his results in the *Geographical Journal* for May 1923. "The diagrams I have made," he writes, "are nothing less than accurate plans of the

fields of a group of communities which ceased to exist about 1,500 years ago. Remains of the villages where lived the people who cultivated these fields can still be seen upon the downlands of Wessex and Sussex." The essential function of air photography is that it makes evident the plan and arrangement of ancient fields and roads which, from the ground, appear only as broad banks with no definite arrangement. Their relation to remains of known Roman origin proves that they were in existence before the Roman conquest. They prove that agriculture was well developed in southern England long before that event. Moreover, it is evident, from the isolated round white spots due to localised patches of chalk, that the custom which still persists of "marling" or fertilising the fields with chalk brought from a distance was established in very ancient times. These cultivations, the author believes, were the works of Celtic communities; the Saxons preferred the rich valleys by the streams. It is strange to read of the long-forgotten relics of ancient days brought to light by the aid of one of the newest of scientific methods—air photography. Above all, these discoveries serve to emphasise again the antiquity of the downland, and its grandeur, unspoilt as yet by all the artificiality and commercial development of modern England.

"But here the old Gods guard their round,
And in her secret heart
The heathen-kingdom Wilfrid found
Dreams, as she dwells, apart."

* * * * *

We feel that the importance, even greater to all who love their native land and its gradually vanishing countryside than to the specialised interest of the archæologist, of restraining the hand of the spoiler in the shape of the advertiser, justifies a reference in this place to the Bill now before Parliament to curtail his activity. A peculiarly offensive example is to be seen, carved in the chalk outside Lewes, in the heart of Downland, in letters many yards long. It is a most unpleasing experience to walk from the Long Man of Wilmington, carved in the chalk unknown hundreds of years ago, to this modern atrocity. We trust that the Bill will safely make its way through the devious routes of Parliamentary procedure, and take effect at an early date. Surely the feeling of antagonism inspired by the thoroughly distasteful exhortation to purchase some commodity must completely outweigh the advantage of any publicity so gained. Unfortunately, a determination never to purchase any article so recommended would quickly prevent a public-spirited individual to-day from buying anything, so widespread is the habit. But, short of legislation, such a course seems the only logical way to set a term to the nuisance.

The Structure of the Earth[1]

A New Theory

By O. H. T. Rishbeth, M.A.

Reader in Geography in the Southampton University College of Wessex

This is the century of world views and world vision in matters of business, social construction, and politics; it is also the century of world aspects in matters intellectual, in history, economics, and, not least, in geography and geology. There is a growing interest in problems connected with the physical nature of our world as a whole, its composition, structure, the distribution of elements in and upon it, and the reasons for that distribution. Recently prominence has been given in discussion to Wegener's theory[2]—the theory of the drifting apart of continents. It may be of interest to acquaint ourselves with another theory, even more ambitious in its scope, which will perhaps come prominently into notice, and which bears the marks of greatness. The theory is the result of "long years of study in the field and in the literature of the subject," and its author, since the appearance of the book in which he sets it forth, has been appointed to one of the most important chairs in his subject on the Continent.

The problem of mountain-building has long occupied the minds of thinkers, and its connection with the equally absorbing subject of the nature and structure of the ocean basins has become increasingly emphasised. The Pacific is bordered by chains, the apparent remnants of a mighty mountain girdle. The great Eurasiatic mountain-zone breaks off east and west into oceans, is flanked by flooded hollows almost throughout its length, and is never far from the ocean. Nearly all the great mountain systems, old or young, are contiguous to continental margins,[3] while the hearts of the continents are relatively undisturbed. The existence of mountains and orographical features generally on the ocean floors has long been recognised, and although the whole subject remains a field of conflicting theories, the great oceanic troughs (geosynclines) are frequently regarded as the wombs or the graves of mountains.

Kober builds with existing materials. His method is evolutionary rather than revolutionary: he absorbs,

[1] L. Kober, *Der Bau der Erde* (Geb. Borntraeger, Berlin, 1921).

[2] For an exposition of this theory by Professor Wegener himself, see Discovery, vol. iii, No. 29.

[3] The main exceptions (e.g. Altai and other Central Asiatic block-mountain systems) are more apparent than real. (Vide infra.)

though critically, the results of many investigations and creates a higher synthesis of his own. Old facts appear, but in a new light; halting half-truths gain a new relevancy and live in a larger and wider meaning. The conception is so vast in scope and involves such a universe of detail that here we can give the merest outline, though no outline can do justice to it.

number of relatively firm blocks separated from each other by zones of less solidified and more plastic material. The geological history of the earth is occasioned by the interaction of these two fundamental elements.

The blocks are to be thought of as great table-like expanses, of irregular outline, worn flat [1] through age-

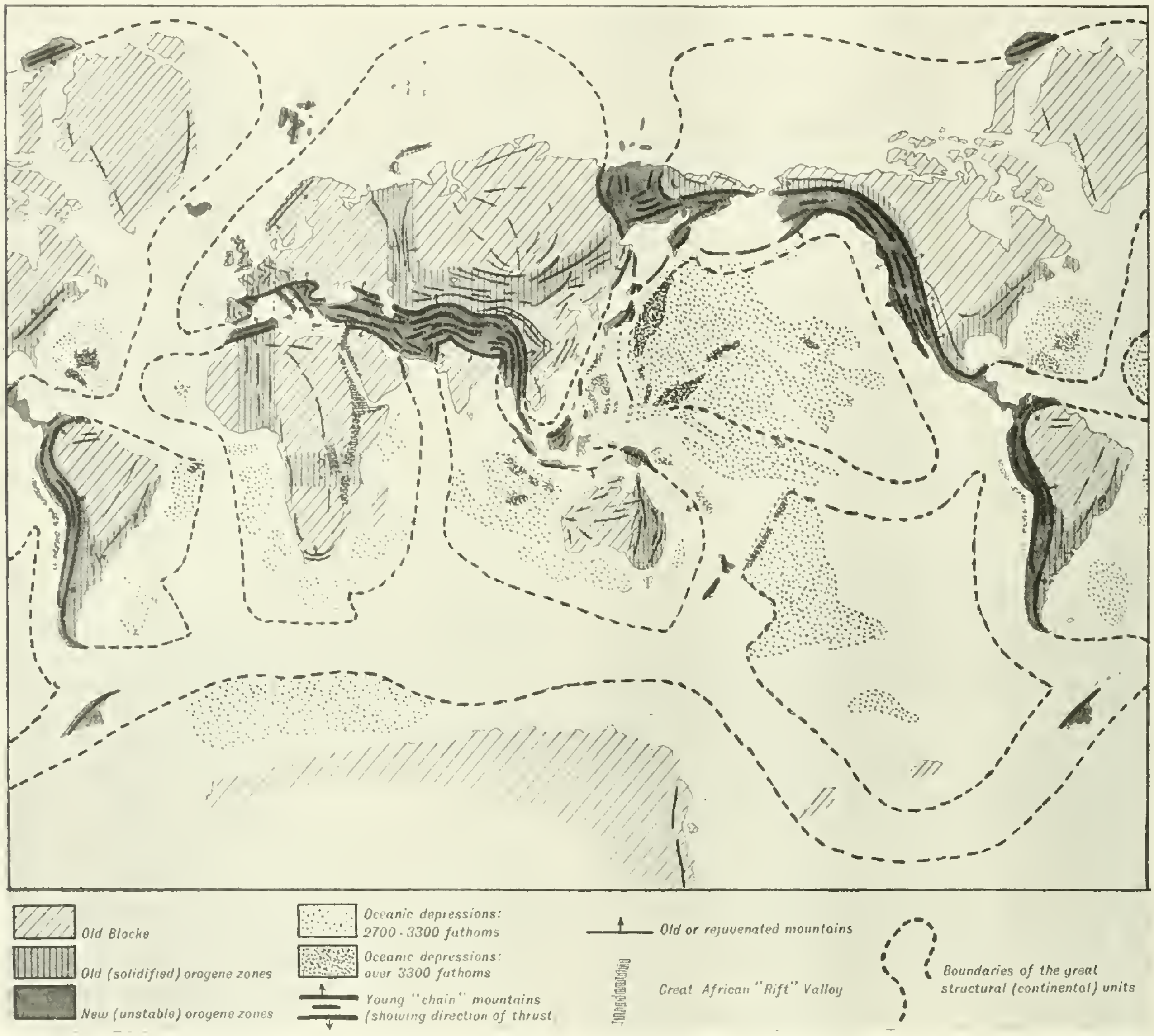


FIG. 1. MAP SHOWING MAIN STRUCTURAL FEATURES OF THE EARTH.
(*Adapted from L. Kober: "Der Bau der Erde."*)

long erosion. They must lie at approximately one general relative level which is (for their surfaces) very nearly the mean general elevation of the land-surfaces of the globe. The Russian, Siberian, Australian Tables and the Canadian Shield are examples. These old blocks are composed of intensely crumpled,

The dominant cause of movements of the earth's crust is earth contraction due to earth cooling. Other causes (astronomical, geophysical) undoubtedly operate, but they are neither so constant nor so general. Other causes, again, are derivative, secondary, or later results of the great primary cause, shrinkage.

When it emerged from the astronomical into the geological stage the earth had a crust composed of a

[1] Really *convex*, according to the curvature of the earth's surface.

crushed, and compressed materials as foundations, with, on top, relatively thin layers of flat-lying sediments. They form the permanent cores of the continental masses.

Compared with them the plastic zones are, in their extended form, 3,000 km. (1,800–1,900 miles) broad, shallow depressions (geosynclines) filled with sea. Compressed they appear as zones of "chain" mountains having a fairly uniform width of 1,000 km. (620 miles). The Atlantic is probably an instance of such a zone in its hollow (geosynclinal) state; the Alpine-Himalayan mountain-band is a young example of the compressed type. These zones wind sinuously around the continental blocks and every block is completely ringed in by such zones. (See map.)

Formation of Mountain Zones

As the earth contracts the blocks are brought closer together. By their nature and position they have little choice of movement. At first they will draw together in one and the same horizontal plane. They are the active agents, exerting pressure. The brunt of their onset must be borne by the plastic zones. These we must think of at first as in their hollow (geosynclinal) stage, sea-filled and having floors weighted (in all probability) by vast masses of heavy igneous rocks. Also, as great masses of debris from the surrounding lands keep gravitating into them (especially around their edges) their floors keep sinking and deepening and encroaching by dragging down the continental margins.

When pressure is applied this deepening process is accentuated, and it appears to go on until a depth is reached where the temperature, the plasticity of the rocks, and the thinness of the earth's crust at last permit the magmas or underlying fluid strata to force their way up. The process is then reversed: pressure continues and the floor starts to bulge and buckle. The first bulging will take place in the middle of the trough and approximately along its axis (i.e. parallel to the sides of the inpressing blocks). The seas will now begin to be forced out and their encroachment on

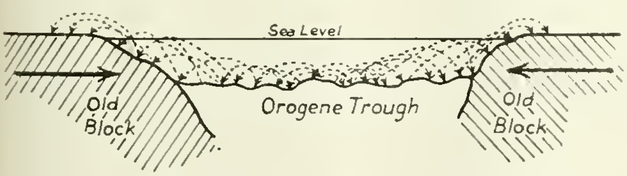


FIG. 2.—THE "PRESSING OUT" OF AN OROGENE TROUGH.

the lands (see above) will be accentuated. As pressure continues other ridges form on the floors of the trough, parallel to the original bulge and extending outwards on either side from it. If there are any harder lumps in the floor they will serve first as occasions and then as the cores of the growing folds (as a dead camel may cause a sand-hill). The blocks press in, the ridges press outwards. Pressure intensifies: the ridges jostle, mount up, push over one another, press some up and out, others in and down, in the search for room and still more room. The deeper and more compressed

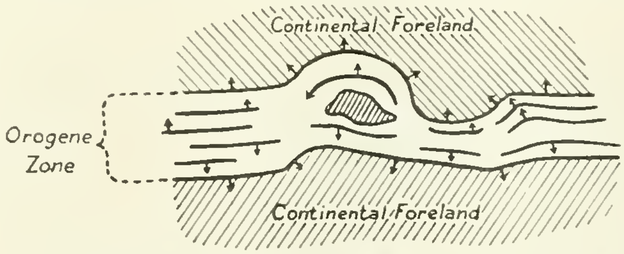


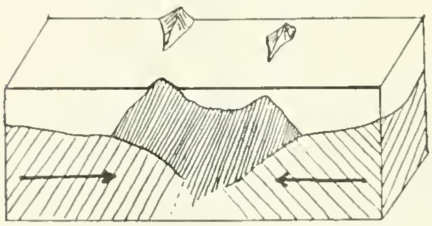
FIG. 3.—DIAGRAM TO SHOW MOVEMENTS IN OROGENE ZONE.

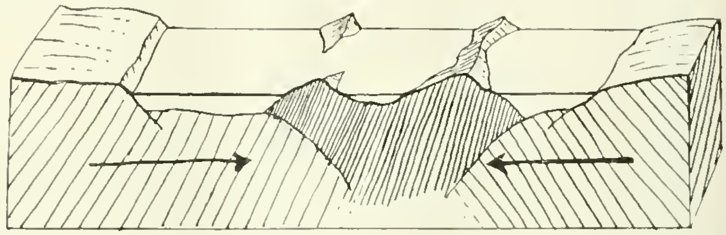
parts are more plastic and serve as gliding planes for the more refractory materials above. The trough is now truly an orogenic zone, a zone giving birth to mountains. Ridge mounts on ridge, and above the shallowing out-flooding seas rise peaks, island rows, island chains, archipelagoes. Then up the inclined planes formed by the continental margins on either side press the ridges, layer thrusting over layer, advancing against the solid land like great frozen waves, their steepest "breaking" faces always in front (outwards). Last of all the whole system is pressed up high and dry: the geosyncline is "pressed out"; it is one-third of its original breadth; it has become a zone of mountains. (Figs. 2–6.)

These mountain zones are eloquent of their origin. Their materials reveal their birthplaces—the shallow, deep, or abysmal seas or the deeper rock zones underlying these. Their structure, infinitely complicated by reason of their history, can generally be unravelled, and this structure is most striking.

Every orogene zone is two-faced. It is as though two giant armies had advanced, back to back, each against an onpressing continent, and each had been frozen where it stood. In the front line are the tallest aggressors frowning abruptly out upon the lands. Where they tread the plains subside, and the Himalayas, the chains of Iran (and many others) are fronted by deeps (Ganges Valley, Persian Gulf, Mesopotamia). The line of advance may be in any direction of the compass, but always it is against the continental block. (See Fig. 3.) Sometimes the advancing giants shovel or push up the land in front of them, and then they are confronted by a shelf-like plateau (Colorado Plateau). (See Fig. 6.) Where the great blocks press hard together, there is intensest distortion and a knot (Pamirs; Armenian Knot); where the pressure is less intense, there are intermont areas, generally plateaux (interior Asia Minor; Thibet). These, having been forced up from the trough floors, are

mostly of heavier materials, and, when the pressure is relaxed, they may subside and form basins (Hungarian Plain).[1] Where the advance is unopposed, it is in line (Pyrenees, Caucasus); where it is held up at points, the rest of the front moves forward into great betray the stresses which the continental block has suffered. (See Asia on map, Fig. 1.) Sometimes even a whole block seems to be depressed or elevated: in the Pacific a block (or two blocks), after having helped to create the great girdle chains, seems to have sunk.





FIGS. 4 AND 5.—KOBER'S DIAGRAMS ILLUSTRATING THE PRESSING UP OF THE OROGENE TROUGH INTO ISLANDS AND ISLAND CHAINS.

arcs [Aleutian, Japanese (East Asian), Carpathian, Dinaric, Tauric arcs].

Concretion of Continental Masses

Though stiff and unyielding, the Old Blocks do not come off unscathed. Comparatively free from the volcanic and seismic travail which marks the birth and death of mountains, they yet buckle, crack, tilt, and sag under the tremendous strain. Every block is ringed round by an orogenic zone, and exerts and suffers pressure from all sides. Doubtless the incidence of the pressure is unequal both in place and time, and mountain zones—or even single mountain chains—must not be thought of as rising or sinking simultaneously and evenly always and all over the globe. Nevertheless, the great tectonic disturbance lines of the continents—the lines of new, old, rejuvenated mountains, of scarps and fracture-valleys—are ranged concentrically around the continental blocks, the most violent around the edges and fading away gradually, like ripples, inwards so that the hearts of the continents remain almost unmoved. Such dominant lines, by their insistence and their compromises, clearly

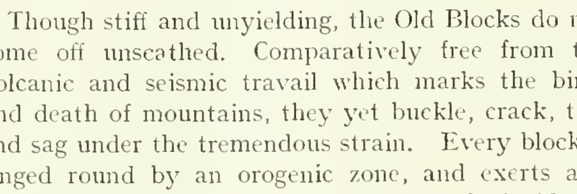


FIG. 6.—KOBER'S DIAGRAM SHOWING (1) THE FORMATION OF A TYPICAL OROGENE MOUNTAIN SYSTEM; (2) THE PUSHING UP OF THE EDGE OF THE CONTINENTAL BLOCK UNDER PRESSURE (COLORADO PLATEAU).

[1] Kober points out that in the great Mid-World (Mediterranean) Orogene System these intermont blocks sink steadily, along with the sinking of the whole mountain system, as we go westwards from its highest part in Central Asia. Thus Thibetan Plateau: average elevation c. 12,000 ft. (cf. *Roof of the World*); Persian Plateau: c. 6,000 ft.; Asia Minor Plateau: c. 3,000 ft.; Hungarian Plain: c. 300 ft.; West Mediterranean Basin: below sea level.

Still, in spite of temporary flooding and submergences, whole or partial, the blocks are permanent elements in the earth's crust. They are continental cores, units from which continents are built. For the last fate of a geosyncline is to be permanently "pressed out," "landed," to become a rigid mountain zone soldering two blocks together. Thus Eurasia is compacted of at least three blocks permanently concreted and, in spite of the superficial flooding of the Mediterranean area, it is likely that Africa also is now finally cemented to Europe.

Subsidence of Mountain Systems

But this happens seldom. The materials squeezed up from the geosyncline are relatively loose, and they are forced up to immense heights. They therefore tend to settle. Also, though for the most part relatively light, they represent in the mass an enormous weight. They are piled up on the continental margins, and these, unequal to the strain, sag. The whole orogene structure is, in fact, unstable, as the vast ruins of water-logged mountain systems, especially along the continental margins of the world, attest.

Thus it comes that the seas, which were sent flooding out far and wide by the steady rise of the mountain zone, contract again and drain back as the continental edges—and, indeed, the whole orogene system—subside. This subsidence is due ultimately to continuous earth contraction. We witness the rebirth of an ocean. Spent, as it were, by its mighty effort, the mountain zone sinks back and in its place is a trough of the sea. Along with it it has carried (to various depths) large portions of the surrounding continents, and the existing land-masses are little more than cores, stiff kernels, of much larger structural units. [See Fig. 1 (map)]. On the floor of the new oceanic geosyncline are preserved at least the vague lineaments of the orogenic zone, its 1,000 km. broad highland, its great frontal deeps, and in addition the great flanking hollows caused by continental subsidence. (See Atlantic on map.)

This, then, is the life-cycle of the great earth synclines—first oceanic troughs, then mountain zones, then troughs again. The last fate, as we have said, of the geosyncline is to become rigid and dead,[1] the cement of continental blocks. The world is probably now in a geosynclinal stage, and at least two, and probably three, cycles such as have been described make up geological history.

The plastic zones show throughout the ages a remarkable permanence of position. Mountains arise where mountains have stood, and oceans repeat oceans. The new mountain zone swallows up the old, builds upon the foundations, and with the materials of the old, and where this is not completely the case the old worn-down stumps are awakened, pressed up again by the new movements into life. Thus while the continents possess the permanence of stability, the plastic zones possess a permanence of change.

An Epoch-making Theory ?

If Kober's theories are substantiated, many current notions will have to be revised. The great (hypothetical) land-bridges between South America, Africa, and Australia, between Africa and Europe, will be heard of no more.[2] Many theories as to detailed features of the earth's structure (e.g. those concerning the great Central Asiatic mountain-systems, the great African Rift Valley, the Atlantic Ocean) will need modification. Into these we cannot enter here. Nor shall we indicate the larger inferences drawn by Kober as to the general structure of the earth, except to say that he arrives at an octahedron, that is, a solid figure contained by eight faces, of which the flat faces are not the oceans [3] but the great land masses. Interesting as these speculations are, they must probably await the establishment of their premises.

It is possible that Kober's book marks an epoch : that in its field it represents a Newtonian achievement. Kober himself is fully aware of the incompleteness and insecurity of much of his evidence, but this makes his confidence the more impressive. Critics will perhaps think his building-plans outrun his materials, that construction has been pushed to insecure heights. Kober himself regards his book as an essay, and hopes it will stimulate investigation. This, it is safe to say, it will do. If, like Kober's own orogene system, his theory sinks back into the great geosyncline of oblivion, none the less it will have been a splendid achievement of intellect. We strongly suspect that it will not sink back, that it will become the cement of continents of knowledge.

[1] Except that, as pointed out below, such "congealed" orogene zones are peculiarly liable to fracture, to be reawakened by pressure in later ages.

[2] Kober is not unmindful of palæontological evidence, but he is summary in this respect. We surmise that he will have ultimately to reckon seriously with the biological aspects of his theories.

[3] In the well-known "tetrahedral" theory as expounded by Green, Gregory, and others, the flat faces of the hypothetical tetrahedron are the *oceans*.

*

On Ford Cars to Siwa Oasis

By Major W. T. Blake

THREE thousand years ago the oasis of Siwa was one of the most famous places in the world. Now it has lost its fame, and is indeed unknown even by name to the majority of people, but in interest and beauty it still retains its position. Rock tombs containing mummies, beautiful date and olive groves, the ruined temple of Jupiter Ammon, hoards of buried treasure and lost emerald-mines, all contribute to the interest of Siwa, whilst the people themselves are of the Senussi breed, the most fanatical of all Mohammedans, for it was here that Sidi Mohammed Ben Ali, the founder of the sect, settled in 1838, making it his headquarters.

Owing to its position, over 200 miles from the sea and about 400 miles west of the Nile, and to the fact that it is thus surrounded by the inhospitable desert of the Sahara, it has long remained inaccessible to the traveller. From Alexandria or Cairo it is a fifteen-day journey by camel. Now, the coming of the aeroplane and the Ford car have altered matters, and it was by Ford that I recently made a journey across the desert to this remote oasis.

The Recently Formed Desert Touring Club

In Egypt an organisation has been created called the "Desert Touring Club," which has as its object the exploration of little-known parts of the desert by means of Ford cars. The journey to Siwa was the first big trip that was undertaken. The party consisted of nine people, all, with the exception of myself, residents in Egypt, and set off from Alexandria in three Fords of standard type, except that the bodies had been removed and replaced by shallow platforms. Each car carried three people, petrol for 1,000 miles, water, food, arms, and camp equipment. On the second stage of the journey a further addition was made to the party in the shape of Suleiman, a Bedouin guide provided by the Government authorities, to help the expedition across the open desert.

We left Alexandria at dawn, making for Mersa Matruh, some 200 miles west along the African coast. This spot was one of Cleopatra's favourite resorts, and

the ruins of her palace are still to be seen there. Up to this point the journey was comparatively simple, as a clearly defined track known as the Khedevial Road runs the whole way. In most places the going was fair, and by six o'clock the expedition reached Matruh, having travelled a total distance of 310 kilos in eleven and a half hours, including halts made for lunch.

This part of the expedition was made over comparatively uninteresting desert, as at no time were we more than about ten miles from the sea, and in most places scanty vegetation was present. From time to time we passed grazing herds of camels, or an occasional Bedouin encampment, whilst the glistening white bones of camels which had fallen by the wayside when travelling through the desert showed us that we were on a regular caravan route.

FIG. 1.—ENTERING SIWA THROUGH THE ESCARPMENT.

The Journey South

Next day we were up long before dawn to prepare for the 250-mile journey south over the open desert. This time it was no question of crossing "tame" desert. Once the littoral had been left behind and the escarpment climbed the scanty camel-thorn grew even scarcer, and soon we were in the vast expanse of boulder-strewn desolation, with nothing to be seen except rocks of all sizes, and occasional eminences topped with cairns as landmarks to Arab caravans. Skeletons of fallen camels grew more numerous, their bones glistening whitely by the *mashrabs*, or camel tracks. Occasional piles of stones with spaces cleared in front of them marked the graves of Arabs who had died in the waterless desert.

Our guide, Suleiman, brought us along without pause, such slight indications as the faint marks of camels' feet in the sand and carelessly placed pieces of stone being sufficient to show him that he was on the right track.

After a time we came out of the stony desert into a series of depressions where salt-pans and mud-flats had formed, and here the going was so good on the excellent smooth surface that the cars went along hour after hour at an average speed of 40 miles per hour.

Towards evening we sighted a line of curiously carved low hills in the distance, which Suleiman informed us were the hills to the north of the oasis of Siwa. We dropped down through the escarpment amongst weather-worn sandstone and entered Siwa town just before dark.

Appearance of the Oasis

The oasis of Siwa consists of a depression about 72 feet below sea-level, thirty miles long and six miles wide. It is well watered by about 200 wells, and the rich soil produces wonderful olives, perhaps the best dates in the world, and apricots, melons, grapes, and many other fruits.

We slept that night on the Hill of the Dead, a mound covered with rock tombs, most of which had been opened by the Siwans in order to obtain the stone sarcophagi, which they use for the storage of food. From the summit of the Hill of the Dead one obtains

a splendid panoramic view of the oasis, with its palm groves, wonderful blue lakes, and the two villages of Siwa and Aghourmi.

FIG 2.—THE WALLS OF SIWA TOWN.

The houses in Siwa are built upon the face of the rock, one on top of the other, being broader at the base than at the roof, so that the houses have a conical aspect. Mud and palm trunks are the materials for their construction, and doors and windows are just holes made in the walls. Many of the houses interconnect, and narrow passages winding in and out form the roads. Goats, sheep, and chickens share the houses equally with the human inhabitants, and the smell exuding from the houses is excessively powerful. The houses of the sheikhs and notables are distinguished from those of the ordinary inhabitants by having broad bands of whitewash painted across the front.

FIG. 3.—SIWA SHEIKHS AND NOTABLES.

Aghourmi, a village about two miles to the east, is smaller than Siwa, but built on the same plan, or rather lack of plan.

Camels cannot live in Siwa owing to the existence of the "gaffar" fly, so that donkeys are the chief means of transport, and they, with goats and sheep, abound.

The Natives and their Customs

The people of the oasis number a little over 3,000, but are dying out through intermarriage. They are not of Arab stock, but seem somewhat allied to the Berbers. It has been suggested that they are the descendants of the expedition sent out from Egypt by Cambyses the Great, which expedition never returned to the Nile Valley. A disease known as Siwa fever, of malarial type, is further helping in the destruction of the population.

Strangely enough, many of the men are physically fine, heights of 6 feet 6 inches being common, and the build big in proportion. Some of them have fair hair and blue eyes. Though Senussi, they are very pro-British—possibly as a result of the war, when Ford cars and aeroplanes first appeared in this fanatical spot, which had previously been untroubled by Europeans.

Siwan marriage customs are free and easy. The people marry very young, and as a rule, by the time a girl is eleven or twelve years of age she has been married and divorced three or four times. Generally speaking the inhabitants are very punctilious about the question of divorce, carefully divorcing one woman before they marry the next, though in a lifetime a man will frequently marry from thirty to forty wives. Needless to say, the birth-rate is low.

On the night before the first marriage the maidens bathe in a well set apart for their use. It is a beautiful palm-fringed pool about 20 yards across and 40 feet deep from the bottom of which water bubbles up, overflowing through an outlet into an irrigation brook. It is faced nearly to the top with blocks of stone, the work probably having been done from three to four thousand years ago.

Wives, whatever their station, only cost 24s. each, so that there is small wonder that the Siwans make frequent changes. Probably, however, 24s. represents a large sum to the Siwan, for on my asking the sheikh if there were any wealthy men in the place, he gravely replied that there were several exceedingly rich men, possessing fortunes of quite £1,000 each !

One of the social customs is that when a woman calls on another she wears all the clothes she possesses, and during her visit discards them one by one, placing them in a heap at her side, in order to impress her hostess with her wealth.

As regards food, the Siwans eat anything, but have a decided preference for dogs, cats, rats, and mice. It is indeed impossible to keep a dog or a cat to deal with the hosts of rats and mice, as they so soon disappear into the cooking-pot.

FIG. 4.—RUINS OF TEMPLE OF JUPITER AMMON.

The Ruined Temple of Jupiter Ammon

The principal building of interest in the oasis is the ruined temple of Jupiter Ammon. This was founded by priests from Thebes in 1385 B.C., or 200 years before the oasis was colonised by Rameses III. Siwa was then known as Ammonia, and after the temple was built it began to gain fame as the home of an Oracle. So famous did the Oracle become that the Athenians kept special galleys to convey questions to it for solution, their expeditions coming by sea to Mersa Matruh, and thence over the desert by camel. In 331 B.C. Alexander the Great visited Ammonia to

inquire into his mysterious origin, and as the Oracle intimated that he was of divine birth, he left, after offering gifts of tremendous value to the temple.

The Oracle was made in human figure, with a ram's head, and communicated its decisions to the priests by means of tremulous shocks, and movements of the head and body.

In the sixth century A.D. the place began to lose its position, but some twenty years ago a considerable number of ruins still remained. These were blown up by an officer sent out by the Khedive of Egypt in order to provide stone to build his headquarters, and all that now remains is part of a gateway and a few huge blocks of sandstone, covered with Egyptian hieroglyphics.

Immense treasures are believed by the inhabitants to be concealed somewhere in the oasis, and there is no doubt that gifts of tremendous value were brought to the temple of Jupiter Ammon, and probably concealed somewhere by the priests. The sword and seal of Mohammed are also supposed to be concealed somewhere in the oasis.

Rock Tombs

Rock tombs abound in the oasis and in the hills in the vicinity. Comparatively few of these have been opened, and there is every possibility that interesting finds might be made if excavations were carried out; but great difficulties in the shape of transport would be encountered before work could be attempted. Emerald-mines also exist in the neighbourhood, though their position has long since been lost. From time to time, however, Siwans discover stones in the ordinary course of their agricultural labours.

The "Desert Touring Club" returned from Siwa in much the same way as it had set out. Throughout the journey the cars ran splendidly, the only breakdown of any nature being the fracture of a low-tension wire, which was repaired in about ten minutes.

It is not a journey to be attempted lightly or by those who value their own comfort, for by the time we returned to Alexandria we were sore with sand and sun, our faces were skinned, and hands, arms, and legs blistered by the heat. Food, too, was necessarily of the roughest nature, but nevertheless the journey was one of the most interesting I have ever undertaken, and was worth all the discomforts of the trip.

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Suspended Animation—II

By Sir Arthur E. Shipley, G.B.E., F.R.S.

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Fish

A VERY considerable number of vertebrates (animals with backbones), for instance the *Carp*, bury themselves in mud during the winter and live with life in abeyance. This may possibly account for the great age to which carp live, namely from fifty to one hundred years or even longer. They are very prolific, and like all long-lived fish they grow slowly, but attain a considerable size, running up to 50 lb. The carp is really a native of Persia and China, and was introduced into Europe in the middle of the thirteenth century. It was known in England towards the close of the fifteenth century.

At the very top of the fishes are animals which have almost turned into AMPHIBIA, for they have lungs as well as gills. One of these, *Protopterus*, lives in the western half of Africa and spreads through the whole of the tropical regions of that country. During the dry season, which in this part of the world is in the summer, these animals, living in shallow water which periodically dries up, retire into the mud and make a kind of clay ball which is lined and held together by a secretion of slime. These clay balls, if dug up unbroken, can be transported about the world, and if placed in tepid water, the capsule gradually dissolves and the fish emerges. Another two-lunged fish of the same family, *Lepidosiren*, occurs in tropical America, and it also is stated to make mud capsules. As these fish mostly go into retreat during the summer, they are said to æstivate and not to hibernate.

The Carp family, as has been already mentioned, hibernates, but not completely, and the same is true of certain eels. None of these fish fall into a complete state of coma, as reptiles and mammals are apt to do, but all their living functions are reduced and lowered. They cease to feed, they cease to look for food, and retire into holes and crannies where they are sheltered from their enemies. In India certain fishes can survive embedded in the mud for several years, and ponds which have been dried up for some time become rapidly crowded with fish when water again enters them.

Amphibia

When we leave fishes and come to the *Amphibia*, the frogs and the newts—animals which live part of their life in the water and part on land—we find that they are creatures which can live for many months without food. In the cooler parts of the world many of these hibernate in the mud; in hot climates they

take up a similar habitat, but that only during the dry season. They can endure a surprising amount of cold, at any rate those of the temperate region, but they will not survive being frozen hard as the carp will. Frogs hibernate generally in masses together at the bottom of ponds, but if reached by prolonged frosts during exceptionally severe weather they succumb. This is especially true of the younger animals, the older being more experienced and more successful in finding safe retreats. Frogs which have just hibernated can stand complete immersion under water for eight times the period which will suffice to drown them during the breeding season. The many and repeated accounts of frogs and toads having been buried for centuries in holes in the solid rock and in coal have never been substantiated and may be dismissed as fables.

Reptiles

Amongst the *Reptilia* anyone who has ever kept a land-tortoise knows that it disappears underground during the winter, and fresh-water tortoises hide away in the banks or at the bottoms of rivers. Snakes and lizards disappear into holes in trees or under stones and dry leaves.

The terrapin, so beloved by epicures in the Southern United States, dig themselves into holes during the winter months, and they do not come out until the spring is well advanced. The so-called box-tortoise, a domestic pet in the United States, becomes very tame ; but it must be allowed to hibernate. If kept in a warm house they become fretful in the autumn, refuse all food and drink, and are liable to die unless they can find a cool place to hide away in and sleep for months. If left out-of-doors they burrow into the ground or sometimes hide under a heap of rubbish well out of the reach of the frost. But a warm April day brings them back to life, and then their first requirement is a little drink. The Greek and Moorish tortoises, which are sold from barrows in our streets, and are kept as garden pets, also require to hibernate, and if lured from their winter homes by exceptionally warm days in the early spring, are likely to suffer in health should a cold spell set in, for they are very much less hardy than before they entered into retreat. The gigantic land-tortoises from the Aldabra atoll bury themselves for at least half a year.

Another group of reptiles, the crocodile and alligator, in the tropics æstivate in the hardened mud ; they have been known to exist in this state of seclusion for a whole year without food. Tennant, in his well-known work on Ceylon, recalls the story of an officer who, when camping out one night, was disturbed by a curious movement underneath his bed : the movement was explained in the morning by the emergence of a crocodile. Crocodiles will also hide away in mud at the approach of danger, and like many another animal they feign death.

We have mentioned above that snakes and lizards frequently hide away during the colder months, and it is a curious fact that, should a viper be awakened during its winter sleep, its bite is said to be harmless. Whether this is so or not requires confirmation, but I do not propose to try the experiment myself.

Birds

The naturalist of the eighteenth century, even the gifted Gilbert White, believed that certain birds hibernated. The disappearance of the swallow each autumn, of the corncrake, nightingale, cuckoo, etc., was by them accounted for by the idea that these birds hid away sometimes under water, and rested during the colder months. This view has now been entirely given up, as it is now known that they retire to warmer climates during the winter.

Mammals

Amongst mammals many species hibernate in the temperate and colder regions of the world during the winter. The well-known European hedgehogs, often kept as pets in the gardens of Great Britain, are the largest of our native Insectivores and they hibernate completely. Unlike the squirrel, they store no food, but retire into a bed of moss or leaves and roll themselves up into a ball with all their prickles outside, and remain in seclusion until the spring warmth revivifies them.

There is another curious little Insectivore known as the *Tenrick*, an animal possibly allied to the marsupials of Australia and America. They are generally found in the mountains of Madagascar, and during the colder seasons of the year hibernate for a long period. They fatten themselves up during the spring, and in this condition are much sought after by natives as an article of food. About May or June they retire into deep burrows in the ground and do not re-emerge until the following Christmas.

The common raccoon, which is confined to America, is particularly common in the Adirondacks. It hibernates during the severest part of the winter ; as Dr. Merriam tells us, " retiring to his nest rather early and appearing again in February or March according to the earliness or lateness of the season."

The same author records that the black bear also " hibernates, although its torpor is not deep, and the time of entering upon the winter repose depends upon the severity of the season and the amount of food-supply. The males will remain active in any weather, so long as they can find abundance of food.

The female is, however, compelled to seek shelter sooner on account of her prospective family. The winter den of a black bear is generally a partial excavation under the upturned roots of a fallen tree, or beneath a pile of logs, with perhaps a few bushes and leaves scraped together by way of a bed, while to the first snowstorm is left the task of completing the roof and filling the remaining chinks. Not unfrequently the den is a great hole or cave dug into the side of a knoll, and generally under some standing tree, whose roots serve as side-posts to the entrance. The amount of labour bestowed upon it depends upon the length of time the bear expects to hibernate. If the prospects point towards a severe winter, and there is a scarcity of food, they 'den' early and take pains to make a comfortable nest; but when they stay out late, and then 'den' in a hurry, they do not take the trouble to fix up their nests at all. At such times they simply crawl into any convenient shelter without gathering so much as a branch of moss to soften their beds. Snow completes the covering, and as their breath condenses and freezes an icy wall begins to form, and increases in thickness and extent day by day till they are soon unable to escape, even if they would, and are obliged to remain in this icy cell till liberated by the sun in April or May."

Although in the south the grizzly bear remains active throughout the winter, in the northern part of its range it hibernates. When during the spring it emerges, it has a habit of standing upright against a tree and scoring the bark with its claws. As it usually stands on a base of 4 or 5 feet of hardened snow, the height of its clawings must not be taken as representing the length of the animal, though sportsmen who tell bear stories very often do so.

But perhaps the best known amongst the hibernating animals are found amongst rodents. Squirrels, as we have indicated above, are but partial hibernators. In temperate climates they retire during the winter into hollows of trees. They bury their stores of nuts, or other food, just beneath the surface of the ground in various caches in the woods, and from time to time awake from their winter sleep to feed

The chipmunk, as Dr. Merriam tells us, begins to hoard up large stores of food in the autumn, and being the least hardy of the American squirrels, commonly goes into winter-quarters at the beginning of November, not appearing again until the early thaws of February tempt him out.

The marmots of Europe and Asia also hibernate, the Alpine species making large burrows with a single entrance. The burrows end in a large chamber lined with grass, and here, coiled away from the cold, some ten to fifteen marmots may be found clustered together.

One of the commonest children's pets in Great Britain is the dormouse, and as readers of *Alice in Wonderland* will remember, it is a profound sleeper. The dormouse accumulates much fat at the approach of winter, but a warm day will bring it out to eat some of its accumulated store of fat, acorns, beech-nuts, beech-mast, or corn.

One more example. A certain little lemur confined to Madagascar retires into torpidity during the southern winter or dry season. Before retirement, however, it accumulates an immense quantity of fat in certain parts of its body, notably in the tail, which recalls the appendage of the well-known fat-tailed sheep of the Cape, or Middle East. By the time the lemur emerges its tail has resumed its normal dimensions.

We have seen there is a certain progressiveness in hibernation: some animals come to life during the winter and feed, others remain immovable for months. But in all, the vital processes are much weakened and diminished. Feeding and movement are at an end, the heart-beat is limp and the breathing imperceptible. In those animals that hibernate most thoroughly, life is sustained by their absorbing their own fat.

Human Beings

We have said that one of the attributes of living organisms is that they perform certain actions rhythmically at stated periods. One of the most striking of these rhythms is sleep. We have also seen that this sleep, in the case of certain animals, may be not a matter of day and night, but may be prolonged throughout the winter, or in the tropics throughout the summer. There are many cases in human beings where sleep is prolonged into a trance, and for the most part these trances are not within the control of the sleeper. A trance is a sleep-like state which comes spontaneously, and is independent of any poisons, though of course certain poisons produce profound sleep. It is very difficult to arouse a person from a trance. People subject to them are seldom in perfect health. Very often they are slightly hysterical, and in other cases they are anæmic.

As a rule a trance sets in quite suddenly. There is a case of a girl going into a room by herself and being shortly afterwards found in a state of coma which lasted thirty-eight hours. In another case a young woman went upstairs to change her dress, and was found in a state of trance on her bed which lasted for fourteen days. But the most interesting factor about trances is that sometimes they can be produced at the will of the sufferer. In India, where mystery and magic are very prevalent, it has for a long time been believed that certain holy men called "fakirs," who live a life of privation and often of self-

inflicted torture, have the power of voluntarily placing themselves in a state of suspended animation, which lasts for varying periods. At the end of each period they return to life unchanged and undisturbed. It is a common tale of Indian travellers.

Verworn has recorded an instance quoted from Baird, one of the earliest writers on hypnotism, in the following lines :

" At the palace of Runjeet Singh, in a square building which had in the middle a closed room, a fakir, who had voluntarily put himself into a lifeless condition, had been sewed up in a sack and walled in, the single door of the room having been sealed with the private seal of Runjeet Singh. (To judge from the account, the air, as in all such cases, was not absolutely excluded.) In order to exclude all fraud, Runjeet Singh, who was not himself a believer in the wonderful power of the fakirs, had established a cordon of his own bodyguard around the building ; in front of the latter, four sentries were stationed, who were relieved every two hours and were continually watched. Under these conditions the fakir remained in his grave for six weeks. An Englishman, who was present during the whole event as an eye-witness, reported as follows concerning the disinterment, which took place at the end of six weeks : When the building was opened in the presence of Runjeet Singh, the seal and all the walls were found uninjured. In the dark room of the building, which was examined with a light, the sack containing the fakir lay in a locked box, which was provided with a seal likewise uninjured. The sack, which presented a mildewed appearance, was opened, and the crouching form of the fakir was taken out. The body was perfectly stiff. A physician who was present found that nowhere on the body was a trace of a pulse-beat evident. In the meantime the servant of the fakir poured warm water over the head, laid a hot cake upon the top of the head, removed the wax with which the ears and nostrils were stopped, with a knife forcibly opened the teeth, which were tightly pressed together, drew forward the tongue, which was bent backward and which repeatedly sprang back again into its position, and rubbed the closed eyelids with butter. Soon the fakir began to open his eyes, the body began to twitch convulsively, the nostrils were dilated, the skin, heretofore stiff and wrinkled, assumed gradually its normal fullness, and a few minutes later the fakir opened his lips and in a feeble voice asked Runjeet Singh, ' Do you believe me now ? ' "

Many other cases have been recorded by witnesses of established veracity, and rarely cases have been described in Europe. Dr. Cheyne, a well-known physician of Dublin, gives an account of the case of Colonel Townsend. It is so extraordinary that it is worth quoting :

" He could die or expire when he pleased, and yet, by an effort or somehow, he could come to life again. He insisted so much upon us seeing the trial made that we were at last forced to comply. We all three felt his pulse first : it was distinct, though small and thready, and his heart had its usual beating. He composed himself on his back, and lay in a still posture for some time ; while I held his right hand, Dr. Baynard laid his hand on his heart, and Mr. Skrine held a clear looking-glass to his mouth. I found his pulse sink gradually, till at last I could not feel any, by the most exact and nice touch. Dr. Baynard could not feel the least motion in the heart, nor Mr. Skrine perceive the least soil on the bright mirror he held to his mouth. Then, each of us, by turns, examined his arm, heart, and breath ; but could not, by the nicest scrutiny, discover the least symptom of life in him. We reasoned a long time about this odd appearance as well as we could, and finding that he still continued in that condition, we began to conclude that he had, indeed, carried the experiment too far ; and at last we were satisfied that he was actually dead, and were just ready to leave him. This continued about half an hour. By nine in the morning, in autumn, as we were going away, we observed some motion about the body, and upon examination found his pulse and the motion of his heart gradually returning : he began to breathe heavily and speak softly. We were all astonished to the last degree at this unexpected change, and after some further conversation with him, and among ourselves, went away fully satisfied as to all the particulars of this fact, but confounded and puzzled, and not able to form any rational scheme that might account for it."

Readers of the *Master of Ballantræ* will recollect that in his last desperate effort to escape his enemies the " Master," under the guidance of his East Indian friend, went into one of these states of suspended animation. The last page or two is occupied with a vivid account of the efforts of the Indian to exhume the body of his English friend. " ' I tell you I bury him alive,' said Secundra. ' I teach him swallow his tongue. Now dig him up pretty good hurry, and he not much worse.' The frost was not yet very deep, and presently the Indian threw aside his tool, and began to scoop the dirt by handfuls. Then he disengaged a corner of a buffalo robe ; and then I saw hair catch among his fingers : yet a moment more, and the moon shone on something white. A while Secundra crouched upon his knees, scraping with delicate fingers, breathing with puffed lips ; and when he moved aside, I beheld the face of the Master wholly disengaged. It was deadly white, the eyes closed, the ears and nostrils plugged, the cheeks fallen, the nose sharp as if in death ; but for all he

had lain so many days under the sod, corruption had not approached him, and (what strangely affected all of us) his lips and chin were mantled with a swarthy beard." The Master returned for one brief moment to life, and then sank into that eternal sleep which he had simulated for over a week.

Modern Industries—II.

Lime and Whiting Manufacture in Lincolnshire

By R. C. Skyring Walters, B.Sc., Assoc. M.Inst.C.E.

In a previous communication some of the Great Chalk excavations at Barton-upon-Humber were described in connection with the Portland Cement Industry. It is now proposed to describe some quarries, also very large, situated four to six miles south of the Humber. Here the chalk comprises what geologists call the "Middle" Chalk, which is of a very different character from that of the "Lower" Chalk at Barton. The Middle Chalk contains a great deal more flint than the Lower Chalk. The previous article described how the pure, almost flintless chalk was mixed with river mud or clay and burnt to Portland cement at the works erected on the Humber side. But inland, not only are there no facilities for water-transport, but there is little or no suitable clay at the surface, and the chalk is usually full of flint either in the form of smooth nodules, some of which attain a diameter of 3 or 4 feet and are called "Paramoudras," or in the form of regular layers which can be traced all round the quarry.

The origin of *chalk* is now well known; that is, it is an assemblage of the shells of minute marine organisms and is comparable to, though not necessarily identical with, the ooze or mud found beneath the Atlantic to-day. The origin of *flint* is very obscure. An old geologist once was so hardy as to say that flint was a molten lava that had thrust its way out from the centre of the earth—how it arranged itself in such regular layers was difficult to explain! Modern geologists and chemists affirm that flint is the siliceous (or sandy) component of chalk which has separated out into layers for some unknown reason; a recent suggestion being that the whole mass of chalk was once in a state of saturation with a solution of silica diffused through it. The silica separated itself into bands of flint, absent in the "Lower" but becoming more numerous towards the "Middle" and "Upper" chalks. A striking analogy to this theory may be obtained by inserting certain chemicals in a test-tube of gelatine. These chemicals separate out into well-defined rings comparable to flint, those at the middle of the test-tube being near together, while those farther from the middle are farther apart; the bands being absent altogether at the top and bottom.

Fig. 1.—General view of a "Middle Chalk" quarry.

In Lincolnshire the "Lower Chalk" consists of a greyish-white flintless chalk arranged almost horizontally in beds or layers 50 feet thick. This is divided from the "Middle Chalk" by a band of marl (chalky clay) about 2 feet thick. The "Middle Chalk" is a hard white chalk 100 feet thick with scattered flints and layers of flint-nodules in the upper part. The "Upper Chalk" has only comparatively recently been dis-

tinguished from the "Middle Chalk" in North Lincolnshire, by means of certain fossils which it contains but which do not occur in the lower two divisions. It consists of a hard white chalk, 80 feet or so in thickness, with numerous thin layers of flint.

Fig. 1 shows a general view of part of one of the two great quarries at Melton Ross situate on the main line between Sheffield and Grimsby, which passes between them on a high natural embankment of chalk that has not been quarried. These quarries, each 175 yards long by 100 yards wide and 50 feet deep, have been worked for many years for whiting, and lime for building and agricultural purposes, but the bulk of the output is used for fluxing steel in furnaces.

FIG. 2.—VIEW SHOWING METHOD OF WORKING AND EFFECT OF WEATHERING ON CHALK.

The chalk, or "Limestone" as it is called locally, is won simply by pick and shovel, and occasionally by blasting. It is quarried out in steps or ledges as shown in Figs. 1 and 2. For making whiting, which is chemically pure chalk, there are pan-mills to grind to a paste the pure white beds of chalk which occur in certain parts of the quarry. The slurry or liquor from the pan-mills is run off into settling-pits, from which the paste is dug out by hand and placed in lumps on shelves in long open sheds where it is dried by the air. A certain waste-product is removed from the slurry before it enters the settling-pits. This product is coarse in grain and cannot be used in the manufacture of whiting, although its chemical composition is identical with that of whiting.

The process is quite simple; but good raw material such as is to be found in the "Middle Chalk" is indispensable.

The manufacture of lime, and of the purer variety of lime for steel-smelting, is also carried out in brick kilns in one of the quarries. The process consists of burning the chalk (calcium carbonate) into lime (calcium oxide)—the latter, like cement, having the property of forming another hard chemical compound when mixed with water.

The flint quarried is ground for poultry grit.

Fig. 2 shows the manner in which chalk disintegrates when exposed to the atmosphere for some time, the lines of stratification being almost obliterated. This is seen in the top right-hand corner of the photograph, where there is an old trial-hole which was put down to test the nature of the chalk before opening up the quarry. The photograph shows the lines of stratification of the freshly dug quarry contrasted with the disintegrated chalk of the trial-hole put down two years or so before the quarry was opened out.

Fig. 3 shows a large pit one mile south of Ulceby Church or two miles east of Melton Ross whiting works. The character of the chalk here, belonging to the Upper

FIG. 3.—GENERAL VIEW OF THE CHALK WITH FLINT "UPPER CHALK" QUARRY AT ULCEBY, USED FOR THE CONSTRUCTION OF IMMINGHAM DOCK.

Chalk formation, is very different from that of the Lower and Middle varieties of Barton and Melton Ross. The chalk contains an abundance of flint which renders it quite unsuitable for the manufacture of cement or lime. The quarry was dug on a very big scale in 1906 to supply hard filling material in the construction of Immingham Dock, and has a face of 300 yards and is 77 feet deep. It consists of :

	Thickness of Seam. ft.	in.	Depth of Bottom of Seam below Surface. ft.	in.
Light brown loamy clay, boulder clay	7	0	7	0
Chalk	4	0	11	0
Thick seam of flint	1	0	12	0
Hard chalk with at least 5 flint layers 6 in. thick with a *fossiliferous* layer at the base	30	5	42	5
Chalk with 6 thin seams of flint, main working floor	15	4	57	9
Chalk with 2 thin seams of flint with *fossiliferous* layer at base . .	6	0	63	9
Chalk with 7 thin seams of flint 3 in. to 6 in. thick, some of which are pink lowest working floor . . .	8	0	71	9
Chalk with 2 seams of flint . .	5	3	77	0

Several urchins, typical of the Upper Chalk, found by the writer were identified by Dr. H. L. Hawkins, namely *Hol. Sternotaxis planus* and *Micraster*, sp., low zonal form, and the pretty fish's tooth, *Oxyrhinca mantelli*.

My thanks are due to Mr. G. M. Borns and Mr. W. H. Wicks for much help in the preparation of these notes.

From the Vague to the Concrete in Science

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THERE are several examples in the history of science where an idea at first represented by some purely metaphorical expression became in course of time a concrete existence. Most of the sciences have instances of it . one meets at first with a notion, often of the vaguest, a principle, a property, a potentiality for something or other, and one ends with a substance, a species of matter, tangible and ponderable ; the notion has become incarnated.

Examples in Inorganic Chemistry

Inorganic chemistry offers us an excellent case of this process. When Lavoisier was working out the character of the substance we now know as oxygen, he had not isolated oxygen by a stroke of genius and then proceeded to study the properties of the new chemical product ; the history of its discovery is far otherwise. Acting on some hints given him in October 1774 by the Englishman, Joseph Priestley (1733–1804), Lavoisier (1743–1794) came upon what he soon named as the "principle of acids" or the "acidifying principle": his own words written in 1777 were—

> "I shall therefore designate dephlogisticated air, air eminently respirable, when in a state of combination or fixedness, by the name of acidifying principle or, if one prefers the same meaning in a Greek dress, by that of oxygine principle."

Here it is a "principle," something which combines with metals when they are calcined or burned in air ; it is that something which to Lavoisier seemed essential in acids, that which produced acidity, the oxygine principle. Its later and more familiar form of "oxygen" is better etymologically. Now that which was a principle in 1777 became, a hundred and twenty years afterwards, a visible, tangible entity. The "principle" of 1777 had become a substance by 1897 ; the metaphor had become an actuality.

The word "gas" is itself an example of what we are thinking about. "Gas" and "blas" were arbitrary words coined by van Helmont in 1630 to signify two things in physiological chemistry : the one, carbon dioxide, the other, some super-material power or agency which was supposed to direct the activities of living matter. In the course of time not only carbon dioxide, but many other gases, became known, and ultimately were isolated and even made visible in the liquid state ; whereas "blas" is still the metaphysical concept it ever was. "Gas" has literally materialised because it referred to a form of matter ; "blas" has never got outside the concept or brain of the philosopher.

Not all chemical concepts have been equally fortunate in leading to actual and individual chemical substances ; phlogiston, for instance, denoting, as it did, no reality, is phlogiston the concept still. The principle of heat, phlogiston, was supposed to leave a body when it was burned ; the theory of Stahl (1697) asserted that heat was a thing—a thing which could depart from a body and leave it lighter than previously when it was cold. Now this, as a conception, is quite satisfactory, but as it is not true in fact, phlogiston never materialised ; it was never isolated from matter because it never existed in matter. Phlogiston was as barren as "oxygine" was pregnant. To-day Priestley and Lavoisier could be presented with kilogrammes of the "oxygine" principle, but not a milligramme of phlogiston could be extracted for Stahl, because oxygen is a substance, but heat is a mode of motion.

The Case of the Molecule

Chemistry furnishes us with another example of the thing in the mind, becoming ultimately a thing

in the outer world of matter, namely, the evolution of the conception of the molecule. The atom as Dalton conceived it in 1804 was the smallest portion of matter which could enter into chemical union with some other similar substance, or could replace some other atom in a compound, thus forming a new compound. In course of time the Italian chemist Count Amedeo Avogadro (1776–1856) became convinced that there must be bodies composed of two, three, or more atoms —compound atoms, in fact—which were able to exist in a state of freedom, in gases for instance. Avogadro therefore coined in 1811 the word "molecule" (the diminutive of the Latin *moles* = a mass) "as a term of convenience" to express the conception he had of the smallest portion of matter able to exist in a free state.

Dalton's atom is the unit of chemical activity, Avogadro's molecule is the unit of physical structure. For many a day after Avogadro's time, the atom and the molecule were still "terms of convenience": neither had been seen; but to-day both atoms and molecules are believed in as real existences; and as for molecules, they have been weighed and measured.

The author of a recent textbook of chemistry writes thus: "The Brownian movement has revealed to us bodies intermediate between ordinary particles and single molecules, and has enabled us to estimate the actual weight of molecules. . . . There is thus no question that molecules and atoms are real." Not only so, but the physical chemist can calculate the number of molecules in a given volume of gas. Thus the conception of the molecule has been discovered to correspond to a real, external, physical entity.

Fermentation and Digestion

No better example than that of the ferments could be given of a notion becoming in course of time a substance isolated and tangible. Fermentation, the totality of changes produced in digestible, coagulable, or putrescible material, was for ages believed to be inscrutably mysterious. It was made the subject of debate between the iatro-mathematicians and the iatro-chemists of the seventeenth century, but neither school really understood it.

Digestion, the great fermentative process in animals, was confused not only with putrefaction, but with boiling and with the effervescence of gas in chemical operations. Stahl (1660–1734) saw in digestion the direct activity of the soul or anima which, he held, permeated every tissue and endowed it with its special powers. The chemistry of it all, however, was unknown; the very conception of a ferment, a substance produced by living matter but not itself living, had not as yet emerged from the mental confusion.

Van Helmont (1577–1644), Sylvius (1614–1672), de Graaf (1641–1672), and Haller (1708–1777) all groped for it, but it was not until the work of René Antoine Ferchault de Réaumur about 1750 that any true notion was held as to digestion being a form of fermentation. Réaumur was the first to obtain gastric juice in an approximately pure state and to attempt digestion with it outside the body. Spallanzani, the distinguished Italian naturalist at Pavia, began where Réaumur left off, and discovered in 1777 that digestion was by no means putrefactive, but was apparently due to some "solvent power" or "active principle of solution" in the gastric juice. Then, by degrees, as physiological chemistry improved its methods it obtained finer results, and at last "the solvent power" or "principle of solution" in the gastric juice was isolated in 1862 as the white powder, pepsin, a name which had been given by Schwann to the "active principle" as far back as 1836. Soon other ferments were either isolated or obtained in solution, and to-day in our laboratories we store in glass bottles a dozen or more of those actual substances which are the modern representatives of the "principles of solution" of the early researchers. The vague has become definite, the conceptual power or property has become the material substance or entity.

Diseases of the Thyroid and Pituitary Glands

The story of the isolation of the internal secretion of the thyroid gland—the body covering the projection in the throat called "Adam's apple"—is very similar. Physicians had come to learn that if this gland was in a state of inactivity in early life the condition of imbecility or cretinism was the result, and if the gland became inactive in later life a curious disease called myxœdema was produced. In this latter condition the skin was tumified and the brain showed degenerative changes which were reflected in the loss of energy and in the general lethargy of the patient.

It was also believed that, when the thyroid gland became over-active, a distressing disease, exophthalmic goitre, characterised by a rapid heart-heat, was the result. In course of time it was discovered that cretinism and myxœdema were both ameliorated or cured by administration of thyroid gland; and, on the other hand, exophthalmic goitre was relieved by excision of a portion of the thyroid. An internal secretion was assumed to be absent or greatly diminished in cretinism and myxœdema, but increased in exophthalmos. In due time, at the close of 1914, a soluble, stable, crystalline substance named thyroxin was isolated and found to do everything that thyroid gland itself would do. Three and a half tons of pigs' thyroid have been made to yield only 36 grammes of the hormone thyroxin. Another surmise had been materialised, incarnated, objectified.

The pituitary gland at the base of the brain has also been credited with an internal secretion of wide-reaching power. If its secretion is deficient in early life, a dwarf-like condition is the result ; if, conversely, it be excessive, the individual grows up a giant (gigantism). If the activity of the gland is deficient in adult life, a distressing and progressively fatal disease, called acromegaly, is induced. In this condition the bones of the face, hands, and feet become hugely overgrown.

From the posterior part of the pituitary body there has been extracted a substance (pituitrin) which is a powerful stimulant to the uterine muscle, and as such is daily used by obstetricians.

Insulin and Diabetes

Within the last two years another of these internal secretions, or hormones, has been identified and isolated. The term "insuline" had been suggested by Sir Edward Schafer before 1916 as the name of the substance which was manufactured by the islands of Langerhans in the pancreas and which, carried by the blood to the tissue, enabled them to oxidise the sugar of the blood to carbon dioxide and water. When, owing to disease of the pancreas, this internal secretion was deficient or absent, sugar accumulated in the blood and was excreted by the urine—a condition known as diabetes. At Toronto University a number of workers, directed by the head of the Department of Physiology there, have recently succeeded in extracting from the islands of a healthy pancreas a substance which, if injected into the blood of a diabetic animal, will clear it of its blood-sugar and greatly prolong its life. When administered to human beings suffering from diabetes the effects have been equally striking.

At the close of 1922 more than fifty diabetics had been immensely benefited and had their lives prolonged by this insulin treatment. Diabetes is most fatal in young children. There are children living to-day who some months ago were moribund from diabetic coma.

Insulin has been captured and found incarnated in the pancreas. From this it has been extracted, purified, and bottled.

The Black Death

Another excellent example of the rendering definite what was before of the vaguest is the recent discovery of the cause of plague, the pestilence, or Black Death. In the fourteenth century the great surgeon of Avignon, Guy de Chauliac (1300–1370), attributed the plague to a conjunction of the planets Saturn, Jupiter, and Mars in the sign of Aquarius on March 24, 1345. About the same time the Jews in Germany and Switzerland were suspected of poisoning the wells and were in consequence persecuted and massacred. In the fourteenth century the medical faculty of the University of Paris was asked to deliver an opinion on the nature and origin of plague, but a very great deal that it promulgated was absolutely fatuous as regards protection or cure. One thing only was recommended that is interesting in the light of to-day, namely the fumigation of houses by the burning of aromatic herbs and woods. Only as recently as 1894 was the *vera causa* of the Black Death, one of mankind's most terrible traditions, discovered by two Japanese doctors, Yersin and Kitasato, and named the *Bacillus pestis*. It was soon isolated in pure cultures, grown in artificial media, and its toxins and antitoxins became chemical entities.

The source of the plague was shown to be a bacillus, a most minute vegetable parasite, which growing in bodies of certain animals, rats and other rodents, could give rise to a virulent poison (pestiferin) which was carried to all parts by the circulating blood. It was further shown that man became inoculated by fleas which had been feeding on the bacilli containing blood of rats. Thus were revealed the several links in that long chain which had the *Bacillus pestis* at one end and man at the other. It took mankind three thousand years to come to a knowledge of the truth regarding the cause and manner of the spreading of plague, to a knowledge of that chain of cause and effect which connects microbe and man in the dire relationship of the plague-stricken.

Influenza

Very probably some of the great epidemics of the Middle Ages were in reality what we now call Influenza, its very name being only the Italian for influence, a something inscrutable but omnipresent, mysterious in the last degree. The usual expressions were in vogue—it was a corruption in the air, a miasma, an exhalation, and so on ; until in 1892 the bacteriologist Pfeiffer isolated the organism of influenza and named it the *Bacillus influenzæ*. Not the air, then, but the microscopic fungi it may hold for evil influence, constitute the true cause of influenza. The influence is now materialised, nay, indeed, is isolated and sealed down under glass for the inspection of trained eyes. Thus by the microscope are these deadly powers of the air one by one distinguished from each other and identified each by its particular malignancy.

The story of the discovery of the telescope, how it was bound up with that wonderful emancipation of the human spirit from the thraldom of mediæval ignorance and the hatred of scientific light, has been told us by many learned men ; but I venture to think that the discovery of the microscope, which still awaits its poet, was one fraught with many more beneficent results for humanity. By its scrutiny the invisible

but actual sources of most of the scourges of mankind have been discovered.

We may say in conclusion that the principle of the incarnation of ideas, of the realisation in the world of substance of what had been vaguely foreshadowed in the world of mind, is a process which has gone on in science as surely, if not perhaps so conspicuously, as in art. The artist succeeds more or less perfectly in incarnating his ideas of beauty in stone, pigment, words, and sounds ; but it is sometimes the privilege of the scientist to extract, as it were, the concrete from the abstract, to isolate in material form what was once only a notion, a suggestion, a forecast.

The Respiration of Insects

By I. Leitch, D.Sc.

To the ancient physiologist the problem of respiration had not presented itself as a problem. To Aristotle it was very simple. " For the fact is, some aquatic animals (as fish) take in water and discharge it again, for the same reason that leads air-breathing animals to inhale air ; in other words, with the object of cooling the blood." Leonardo, the greatest biologist between the Greeks and modern times, had perhaps a glimpse of the fact that the process is not so simple. " The air which is inhaled by the lung continually enters dry and cool, and leaves moist and hot. But the arteries which join themselves in continuous contact with the ramifications of the trachea distributed through the lung are those which take up the freshness of the air which enters such lung." But it is only to the biologist of the last few years that the immense complexity and exquisite refinement of the process have become plain.

The nature of the problems involved and the manner of dealing with them are well illustrated by the latest work on insect respiration from Professor August Krogh's laboratory in Copenhagen. Let us take the problem in its threefold aspect : (1) the nature of the demand for oxygen in insects ; (2) the available supply of oxygen ; and (3) the means by which supply is adapted to demand, or, as must happen when the supply falls very low, demand adapted to supply.

The Demand for Oxygen

With regard, then, to the demand for oxygen, there are two factors of prime importance, that of activity and that of temperature. Any animal or part of one, such as a gland or a muscle, will consume much more oxygen when active than when at rest. When all voluntary muscular activity ceases, and other processes are reduced to a minimum (digestion and absorption, for instance, are not taking place), there will still remain a certain residual consumption of oxygen which will just be enough to maintain a completely quiescent state of life. Now the amount of oxygen required by any animal in this resting state is of great importance. The fire of life is burning low ; it is " damped down " to the lowest practical limit. If we can measure the oxygen consumption of any animal in this resting condition, when its metabolic processes—that is, the processes of using the living tissues and their stores, and of building them up again—are at their lowest level, and if we do so under different conditions, say at two different temperatures, then the difference in the amount of oxygen used will measure the effect of the change of temperature. Again, if we measure it with two different oxygen supplies, then the difference in the amount used (if there is any) will measure the effect of the rise or fall of available oxygen. We can, in this way, estimate the influence of summer and winter temperatures, and the influence of a plentiful or a restricted supply of oxygen.

The Supply of Oxygen

With regard to the supply of oxygen, in atmospheric air the percentage is very constant. At sea-level, that is to say, in the habitat of most insects, we find 20·9 per cent. of oxygen, roughly a fifth of the air ; there is just a trace of carbon dioxide, and the remainder may be taken as nitrogen. Under earth, where we find beetles and other insects, the amount of oxygen will vary according to the vegetation and the nature of the soil. At four inches down almost normal percentages of oxygen have been found, but in stagnant soil, or badly drained soil after rain, the percentage of oxygen may be greatly reduced ; values as low as 6 per cent. have been found.

In water the amounts of oxygen, carbon dioxide, and nitrogen present will be proportional to their pressures in the atmosphere, and in nature they will depend in the highest degree on the mixing to which the water is subjected. It will absorb air at the surface, but the air will spread downwards only very slowly by diffusion. Now in summer the surface water is warmest and therefore lightest, and, apart from wind, no mixing will take place. In autumn the surface water is coldest, the water will be well mixed and will be practically saturated with air. At temperatures below 4°, the point of greatest density of water, there will again be no spontaneous mixing, so that a winter minimum would also be expected,

and its non-occurrence is due to mixing by wind. In water with much vegetation the conditions are again changed. The plants give off oxygen, and in absence of mixing, the tension may rise as high as 40 per cent. in the lower depths, a fact that may be of great importance to animal life.

Pupal Respiration

With this short review of the general conditions, let us take the simplest case, the respiration of a pupa in air. Taking demand first, Professor Krogh has shown that chrysalides of *Tenebrio molitor* (the larva of which is the "meal worm") show first, reckoning from the commencement of pupation, a rapidly decreasing oxygen consumption, corresponding to the breaking up of the larval tissues. The decrease takes not much longer time at low than at high temperatures. Then there is a resting period with a nearly constant metabolism, and the length of this pause depends on the temperature. It lasts about 50 hours at 33° ; 70 hours at 27° ; 100 hours at 24° ; and 170 hours at 21°. Thereafter there is a rapid increase in the rate of oxygen use, until metamorphosis takes place. It is interesting to note that the total amount of oxygen used in the process of pupation is the same at all temperatures ; that the process is not more economically executed at one temperature than at another, and there is, therefore, no "best" temperature, except from the point of view of speed.

Now the oxygen is available for the use of the pupa only by diffusion over its surface. Without going very deeply into the laws of diffusion, let us recall the essential points. Gases diffuse much more rapidly in air than in water, and still more rapidly through air than through animal tissues. Carbon dioxide diffuses twenty times more quickly than oxygen, and oxygen three times as quickly as nitrogen. The biological significance of the rapidity with which carbon dioxide diffuses is great. The speed with which it diffuses from animal tissues, where it is constantly being produced, into air or into water, provides that there will never be any accumulation in the tissues, that the chief waste-product of respiration is quickly and easily eliminated. Whether diffusion will take place from any one medium to any other depends on the tensions of the gases present. Thus in atmospheric air over water, if no oxygen is passing either way, we say that there is a tension of 20 per cent. of an atmosphere in the water, and air and water are in equilibrium as regards oxygen. But if there is less oxygen in the water, so little, for instance, that it would be in equilibrium with air containing only 15 per cent. of oxygen, then we say that there is a tension of 15 per cent. in the water, and, in contact with atmospheric air, there will be a pressure-head of 5 per cent. to drive oxygen into the water. The higher this pressure-head, the more quickly will oxygen diffuse into the water. Accordingly the rate of diffusion of air into the body of the pupa will be proportional to the difference in pressure between the external supply and the tension in the body tissues. There will be a point at which the amount of oxygen entering will just counterbalance the consumption, and so, at constant temperature, with constant metabolism, we should expect the tension in the tissues to be at a constant level below the tension in the surrounding air. A rise of temperature—which we saw means an increase in demand for oxygen—with the same oxygen pressure outside, would mean that the tension in the tissues would have to be lower in order that the needs of the animal should be supplied. And, in fact, Dr. Gaarder found that to provide for the needs of the Tenebrio pupa during the resting period, at 20°, a pressure-head of about 5 per cent. of oxygen is required. It follows that a reduction in the percentage of oxygen in the air (while the temperature remains the same) will have no effect on the metabolism so long as this pressure-head of 5 per cent. is maintained. As soon as it fails (and then there will be a zero oxygen tension in the tissues), the oxygen diffusing in will be insufficient for the needs of the pupa. At a higher temperature—Dr. Gaarder took 32°—the oxygen consumption of the pupa in the resting period is a little more than twice as great as at 20°, and the tension in the tissues is 10·7 per cent., giving a pressure-head of about 10 per cent. Thus the pupa will suffer insufficiency of oxygen at tensions lower than 10 per cent. at this temperature. If the supply of oxygen is reduced below these critical tensions, what happens ? The consumption of oxygen falls correspondingly to the fall in the external pressure, but, when the pupa is restored to a plentiful supply, the consumption rate rises at once, not only to the normal, but above the normal, and remains for a time at this high level, finally coming down to the normal rate. When income is not equal to requirements, since the demand is already at its lowest level and cannot be further reduced, reserve measures must be used. The tissue stores are burned in the fire of life without being built up again. The works must be kept going ; capital is used, and when a plentiful income is again possible, the capital must be restored. The income must be abnormally high for a time to balance the period of depression.

That is the simplest case, and it contains all that is essential to the understanding of the general problem. The main arguments apply equally to all forms, to larvæ and pupæ alike, in air or in water, and to the great class of adult insects. Diffusion may be over the whole surface, or through an elaborate system of

air-passages. Let us just note in passing one consequence of these facts, that the possible rate of diffusion through long and narrow air-passages sets a definite limit to the possible size of insects.

Water-beetles

And so we pass on to the complication which arises in the case of air-breathing insects in water—Dytiscus, the "diving beetle," and Notonecta, the "water-boatman," for instance. It is well known that these forms carry bubbles of air down with them from the surface when they dive (some others collect bubbles in the water), and it has long been disputed whether the bubbles are used in respiration, or are merely a sort of "water-wings." Let us take Ege's account of Notonecta. Notonecta has, on the thorax, three pairs of breathing-holes sunk in cavities which are in communication with the depressions in which the abdominal breathing-holes lie, all being roofed in by delicate hairs which form a covered way. There, a layer of air always clings, and this layer is, in turn, in communication with a layer of air on the wings. This air-supply has, as in Dytiscus and other forms, an important hydrostatic function. Without it, these insects, instead of being passively borne to the surface to breathe, become heavier than water and fall to the bottom. Normally, when it is active, Notonecta comes to the surface to breathe at intervals of about 6 minutes. Prevented from so doing, it can live for 6·7 hours in water saturated with atmospheric air. This might be due to any of four possibilities : (1) that the air carried down in the air-passages is sufficient for that time and that the function of the air-bubbles is hydrostatic only ; (2) that the air in air-passages *and* air-bubbles is sufficient for that time ; (3) that the air carried down is not sufficient, but that the animal respires without air (using its capital) ; or (4) that the air taken down is insufficient, but that the animal acquires a further supply from the water by diffusion into the air-bubbles. First, then, a Notonecta deprived of its air-jacket lived only 15 minutes in water saturated with atmospheric air, so that the first supposition is impossible, and the bubbles must be of use in respiration, since it lives 6 hours with them. Next, a Notonecta allowed to fill its air-passages in atmospheric air and then enclosed in water saturated with nitrogen, lived only 5 minutes, so that the total original supply was exhausted in 5 minutes ; and again, allowed to breathe *pure oxygen* and then enclosed in water *saturated with oxygen*, it lived only for 35 minutes. This is not so strange as it seems. The Notonecta carries down a bubble of pure oxygen, and its air-passages are full of oxygen. As it uses up this supply, carbon dioxide will be given off from the tissues into the air-bubble, and, from it, will pass immediately into the water on account of its great solubility in water. There will be no accumulation of carbon dioxide in the air-store. The bubble will continue to consist of 100 per cent. oxygen (while the insect constantly draws from it), and no pressure difference can arise between it and the water. Hence no oxygen can pass from the water to the air-store, and the animal will simply use up its bubble. Under these circumstances it lived for 35 minutes, but there it had 5 times its normal supply of oxygen, 100 per cent. instead of 20 per cent., so that its normal supply would have lasted 7 minutes.

Now, Notonecta deprived of air does not live on its capital stores, for then it would have lived longer in

COMMON WATER-BEETLE (*Dytiscus marginalis*).

nitrogen. What does happen is this: as the insect uses the oxygen available in its air-passages and bubble, the tension of oxygen in the bubble will fall so low that oxygen will pass from the water into the bubble. Ege found that after being 2–4 minutes in the water, the bubbles contain as little as from 5 per cent. to 2 per cent. of oxygen, so that there is a big pressure-head available to drive more oxygen into the bubble. The rate at which oxygen will be supplied in this way will depend on the size of the bubble as well as the pressure-head, and Ege has calculated that for a Notonecta with a full air-supply, which will have a surface of about 75 square millimetres, a pressure-head of 5 per cent. oxygen would be sufficient for the *resting* needs of the animal at summer temperature. At a low temperature, with reduced standard metabolism and little activity, the air supplied by diffusion ought therefore to be amply sufficient to maintain life, even when, as in frozen pools, access to the surface is altogether prevented.

Where the Mechanism Fails

In view of these facts, how does it happen that any limit is set to the life of a Notonecta in water saturated with atmospheric air ? This depends on the fact

already noted, that the carbon dioxide evolved in respiration is rapidly dissolved in the water; in consequence the air-bubbles may always be taken as composed of oxygen and nitrogen alone. Now we saw that a tension difference of 5 per cent. is required for the resting needs of the animal, and the composition of the air in the store would then be 15 per cent. oxygen and 85 per cent. nitrogen. These tensions will be maintained by the uniform consumption of oxygen and elimination of carbon dioxide. But the nitrogen tension in the water is only 80 per cent., so that nitrogen will diffuse out from the air-store into the water and *the bubble will disappear*. In the meantime the oxygen diffuses in three times as quickly as the nitrogen diffuses out, so that, by this means, the insect procures thirteen times as much oxygen as it originally carried.

LIST OF PAPERS

August Krogh, "Ein Mikrorespirationsapparat und einige damit ausgeführte Versuche über die Temperatur-Stoffwechsel-Kurve von Insektenpuppen." (*Biochem. Zeitschrift*, 1914.)

August Krogh, "On the Rate of Development and CO_2 Production of Chrysalides of *Tenebrio molitor* at Different Temperatures." (*Zeitschrift f. allg. Physiologie*, 1914.)

August Krogh, "The Quantitative Relation between Temperature and Standard Metabolism in Animals." (*Internat. Zeitschrift f. physik-chem. Biologie*, 1914.)

Torbjørn Gaarder, "Über den Einfluss des Sauerstoffdruckes auf den Stoffwechsel." (*Biochem. Zeitschrift*, 1, 1918.)

Richard Ege, "On the Respiratory Function of the Air-stores carried by some Aquatic Insects (Corixidæ, Dytiscidæ, and Notonecta). (*Zeitschrift f. allg. Physiologie*, 1915.)

Reviews of Books

WATER AND LIFE, AND OTHER MATTERS

The Animal and its Environment. By L. A. BORRADAILE, Sc.D. (Henry Frowde and Hodder & Stoughton, 18*s*.)

Dr. Borradaile has chosen so vast a subject that, as he states in his preface, he "could do little more than sketch the framework." This, however, he has clothed with many illuminating details. He has shown great skill and sound judgment in his choice of the various aspects of the subject on which he writes. Out of fourteen chapters, six deal with the fauna of the land, the seas, and the fresh water, and these are particularly well worth attention. He has an illuminating paragraph on the part that water plays in the life and structure of animals. William Watson has written a verse:

> "Magnificent out of the dust we came,
> And abject from the spheres."

But I do not think the poet knew much about our origin. As Dr. Borradaile says, "Water is the natural home of all living beings, and there is no doubt that life started in it." Within the body it is of the utmost importance, both as a constituent of protoplasm and as a circulating medium. It is a great solvent. There is no other liquid which dissolves such a number and variety of substances, and, what is equally remarkable, is that on the great majority of them it exercises no chemical action. With the exception of mercury, it has a higher surface tension than any other liquid, and this to some extent explains the mystery of the ascent of sap in trees. It also has the highest specific heat of all liquid or solid substances under ordinary conditions; or, in other words, it requires more heat to warm it to a given number of degrees than an equal mass of any other matter. It is, further, transparent, a matter of great importance to such animals as have eyes, and to animals which are partly nourished by the presence in their body of certain algæ. The remarkable fact that the salinity of our body closely approximates to the salinity of normal sea-water is shown by the fact that living tissues, when removed from the body, are best kept alive when they are in a normal salt solution; and in cases of cholera, where water is being poured forth from the body at an abnormal and amazing rate, the injection of normal salt solution brings relief and often effects a cure. The fact that even in the mammalia the embryo possesses gill-slits and a fish-like circulation and is surrounded by watery fluid is emphasised by Gibbon at the beginning of one of the six sketches of his autobiography. He tells us that "after nine months of an aqueous existence I was painfully transported to the outer world."

Dr. Borradaile writes in a plain, straightforward style, rather compressed owing to the magnitude of his task. As an example of his clearness we may quote a paragraph from his chapter on Parasitism:

> "The relations between *parasite and host* vary enormously, both in kind and in closeness, in different cases. A parasitic organism is one which, living on or in some other organism, and deriving food or some other benefit from it, in some way harms it. The benefit accruing to a parasite is nearly always nutriment, but it may also, or only, consist in transport or shelter. The harm which it does may consist in damage to tissues, abstraction of nutriment, or the excretion of poisonous substances. The series of such cases ranges from some which hardly differ from the preying of a small animal upon a large one—there is no great unlikeness, for instance, between the habits of a mosquito and those of a flea—to internal parasitism of the most intimate kind; and from others that are not unlike the harmless associations of organisms which we shall presently describe as 'synœcy,' to the causing of fatal diseases."

The book has almost an embarrassment of illustrations; so many, indeed, that it is impossible to place them near the subject-matter. There are four good coloured plates and 426 figures, whose reproduction varies in merit. Some of them are distinctly poor. The book is crowned by a most adequate index extending over seventeen pages. Its price of 18*s*. is distinctly moderate.

A. E. SHIPLEY.

THE EVOLUTION OF MAN

The Evolution of Man. A Series of Lectures delivered before the Yale Chapter of the Syma during the Academic Year 1921–2. By RICHARD SWAN LULL, HENRY BURR FERRIS, and others. Edited by GEORGE ALFRED BALLSELL. (New Haven: Yale University Press; London: Humphrey Milford, Oxford University Press, 15s.)

The occasion of the delivery of the lectures contained in this book is sufficiently indicated by the sub-title. Intended as a sequel to a series of lectures on the evolution of the earth and its inhabitants delivered to the same club some few years earlier, they take up the specific study of man from the evolutionary standpoint on several sides. The lectures are six in number. Of these, two are purely physical, one psycho-physical, one psychological, one is cultural, and one, the last, is an attempt to forecast the lines of Man's progress in the future—an attempt which, it may be said, is not so fantastic as might be thought at first sight, but is based on sound methods of scientific analysis.

These essays have a double interest. In the first place, being delivered to a non-specialist but educated audience, as a whole they present a survey of the present state of knowledge in certain departments of anthropology in a form which will commend itself to those who wish to acquaint themselves with the latest results of research, but do not wish to be overburdened with technicalities. In the second place, they represent the current views of American scientists on many problems which are the peculiar province of European anthropologists, and for which the evidence is derived mainly from the Old World and, particularly, from Europe. As a result, matter is presented to English readers from what, in many cases, will be a new point of view.

Of the six essays, the first, by Professor R. S. Lull, deals with the antiquity of man. He surveys the evidence, geological and archæological, for the antiquity of man, adopting the view of Osborne that Mr. Reid Moir's Foxhall flints from East Anglia are to be accepted as evidence for man in late Tertiary times. But it may be noted that he still holds the view at one time general in America, that while the cranium of the Piltdown Skull, the oldest skeletal remains of man found in Britain, is human, the jaw associated with it is simian. Professor Osborne himself has, however, now abandoned this view and accepted it as human. Professor H. Burr Ferris's lecture, on the natural history of man, traces the growth of man from the cell through prenatal and postnatal development to senescence, dealing with each of the organs in detail. This is a very useful exposition of a subject not as a rule adequately treated for the benefit of non-technical readers, and the same applies to Professor G. H. Parker's lecture on the evolution of the nervous system of man. Professor J. R. Angell's essay on the evolution of intelligence contains the essentials for an understanding of the place of human intelligence in the evolutionary scale. If, from the anthropologist's point of view, it may seem too general in character when dealing with questions of racial psychology, this must be attributed not so much to the author as to the fact that it attempts to give an outline of a subject for which accurate scientific data are almost entirely lacking.

Professor Albert G. Keller, in "societal evolution," has chosen to deal with the general principles of study rather than attempt to handle the ascertained facts of the course of development in human society. In this he has shown wisdom, and his lecture will prove a useful corrective to the facile theories which unfortunately have frequently been allowed to usurp the place of clear thinking and accurate detailed verification by comparison with the facts. Of Professor E. G. Conklin's theories of the trend of evolution enough has already been said to indicate that his method is strictly scientific; of his results, each reader must judge for himself. It must be said, however, that in a sense they sum up the teaching of the book and lend support to those who hold that the study of man as he has been in the past and as he is to-day should throw light upon what he will become in the future.

E. N. FALLAIZE.

FREUD ON LIFE AND DEATH

Beyond the Pleasure Principle. By SIGMUND FREUD. Translated by C. M. HUBBACK. (Allen & Unwin, 6s.)

Throughout the development of his theories Freud has always held that the one ultimate motive of all human conduct was the desire to avoid pain or to gain pleasure, though the immediate gratification of the desire might be postponed in the hope of a deeper and more lasting fulfilment. But the suspicion crept in that behind the "pleasure-pain principle" there might be another, altogether different motive, and with the access of new psychological material from the study of the war neuroses the suspicion was confirmed, for in the cases of war shock one of the most frequent symptoms was the recurrence of terrifying dreams in which the patient lived through again and again the experience that caused his illness. Here was a phenomenon that could not be explained by the old formula that the dream is invariably the expression of an unconscious wish.

Freud accordingly gives up the universal applicability of the formula and of the pleasure-pain principle to seek for a new motive in what he has named the tendency to repetition or the "repetition compulsion," a tendency or instinct in every living organism "impelling it towards the reinstatement of an earlier condition."

The phenomenon of repetition is familiar enough in biology, so familiar that, perhaps, we have missed its importance; we have only to recall the compulsive migration of birds and fish back to the original home of their kind, and, perhaps the most perfect example of all, the way in which every individual in its development from the germ-cell is obliged to recapitulate the structural history of the race "instead of hastening along the shortest path to its own final shape."

This conception of a fundamental regressive tendency in the organism is diametrically opposed to our ordinary view of the instincts as urging on towards progress and

development, for it is an urge not towards life but towards death. Freud conjectures that the first living material that appeared upon the globe retained its vital properties for but a short time, quickly relapsing into the chemical stability of inanimate matter, to be vitalised anew by the action of whatever external force it may have been that was effecting so momentous a change in a hitherto lifeless world. But as the living structure became more complex and more different from the non-living, the path back to the inanimate became longer and more circuitous, so that the living organism of to-day is compelled to go through a varied life-cycle before it can return to the inanimate from which it started. Since it is rigidly dominated by the repetition compulsion, it is unable to short-cut the path and is compelled to reach its goal of death by retracing the complicated course of its evolution.

This tendency to go back to the beginning, bound up, according to Freud, in the very stuff of life, is antagonised by the sexual instincts, and it would seem legitimate to consider it (though Freud does not apparently go so far as this) to have been overcome by them, for reproduction ensures a potential immortality for part at least of the organism (the germ-plasm) and has brought about the continuity of living matter.

Here we may note a further modification of Freud's theories; he now groups together "sexual instincts" and the "ego-instincts" (i.e. fear, hunger, and the self-protective instincts generally) as "life instincts," retaining the dualism of his psychology by this conception of a deeper, more primitive, regressive impulse or "death instinct"' in opposition to them.

Evidence of the conservative and repetitive aspect of the regressive impulse is easy to find in human psychology, but the manifestation of its deeper aspect as a hidden but universal striving for death is, Freud admits, very obscure and difficult to detect, and he cites only one example of it.

Even if the supporting evidence were less slender, we should find a temperamental difficulty in accepting a pessimism so profound and unequivocal; Freud himself seems to have done his best to escape his own conclusions, and he will not admit that they are, as yet, much more than speculation, "often far-fetched, which each will, according to his particular attitude, acknowledge or neglect. Or one may call it the exploitation of an idea out of curiosity to see how far it will lead." Yet the conclusions themselves, if we consider them apart from the way by which they were reached, are not so very unfamiliar nor so very different from the pessimistic philosophy of Buddha with its goal in Nirvana that can only be reached when the compulsion to rebirth has been overcome, or the pessimism of all the poets who have sung of their weariness of life and the desirability of death to an unconvinced world. But whether we accept the theory or no, there is not likely to be much tendency to neglect, as their author pessimistically foreshadows, the work of a profound and original thinker, however uncomfortable may be the conclusions to which an unflinching intellectual courage may lead him.

Great pains have evidently been taken with the translation, and Miss Hubback may be congratulated on the way in which she has accomplished a very difficult task.

F. A. Hampton.

A FORECAST OF FUTURE WARFARE

Reformation of War. By R. de la Bere. (Hutchinson, 16*s*.)

This is the title of an imaginative and brilliantly written treatise on future wars. The author is a heretic and "tears up forcibly the old testament of war." In his own words, he believes in original thoughts and "spews out like a nauseous draught the mental drug called imitation." He divides human beings into two classes, the masters (the supermen) and the slaves (the supermonkeys), the creators and the imitators.

In his opinion there are too many imitators in the three services. The world has changed, and so, he considers, has the true art of war. "The brass bottle of scientific warfare has been fished up"; its seal has been broken: and no contempt for science and no reaction to the tactics of the stone hammer, the arquebus, or the matchlock will coax back the Jinn.

Since '70 the art of war has advanced in seven-league boots, and yet, he says, here are soldiers still forming fours and making goose steps. He is out against traditionalism; he is out to slay the dragon of armies and fleets and air services spellbound by the past.

His argument proceeds to practice through biology and ethics. "The law of life is war"; "life lives upon life"; and war in one form or another is inevitable. He has no truck with the League of Nations. War, he thinks, will always be. It is a national tonic—a useful purge.

But to him the art of war is to keep the bulk of your men *alive*.

To keep your men alive, you must keep your movements, your weapons, and your morale alive. Furthermore, you must hit your enemy from a safe distance or you must hit him at safe close quarters. For he claims that there are two great fallacies in the modern theory of war: (1) that in war a nation's will is best enforced by *destruction*, and (2) that victory is based on numbers. These fallacies, he says, led to the slaughter-houses of the Somme and Ypres: whereas, he says, the supreme duty of the soldier is to fight and not to die.

Fighting in future is to be short and safe. He points out that at the preliminary bombardment of the Hooge, the Somme, Arras, Ypres, we fired nine million shells, that is, 100,000 tons of shell, estimated at twenty-two million pounds sterling. If it had resulted in victory, it would have been cheap at the price; but it did not result in victory. Roads, lanes, tracks vanished under the earthquake; impassable craters were formed. It was not modern war. It was, he says, like beginning a big-game shoot with a fortnight's solo on a bassoon.

The writer has no use, then, for shell bludgeoning, e.g. at Gallipoli; or for Brusilov's shock tactics which cost him 375,000 casualties in twenty-seven days; and he thinks that Germany wisely broke from tradition when

our blockade began to tighten. She boldly broke international rules again and started to hit below the belt—in the mind of our humanitarians. But to the writer of this book, war is a game in which there is no belt under which one may not hit. There is, indeed, to him, a great risk of submitting the tactical to the ethical in war.

This is the moral which the writer draws now that, as he claims, in the Services, Tradition is rising again from her ashes—in spite of the stride of new ideas everywhere else. He sketches new methods of war which will compel nations to throw up their hands and make peace within a few days, possibly a few hours, of war being declared.

He says that 1914 saw the last lap of the physical epoch of war; and that " now begins the first lap of the moral epoch."

Firstly he urges the use of gas. It is to be a universal weapon employed by all arms. One of his strongest arguments for gas is the enthusiasm with which most people are agreed to execrate its horrors. The use of gas has been described as " one of the most bestial episodes of the war—the very negation of civilisation."

But Colonel Fuller regards it, properly used, as the weapon of the future, because it is easy and cheap to manufacture; because it economises lives on the battlefield; because the gas of which he is thinking incapacitates without killing; and because it does not injure property. For he is not thinking mainly of toxic gases. He does not regard killing as the object of war. Conceivably it might be necessary sometimes to use toxic gases. Even so, is toxic gas so inhumane as " the weedlings " assert?

The American General Staff have categorised their casualties. Twenty-seven per cent. were due to gas, and 2 per cent. of the gas casualties were fatal. He concludes with them that gas is twelve times as humane as bullets and high explosives. But he urges mainly the use of smoke and gas, which can put troops or civilians temporarily out of action.

He urges the closest sympathy between soldiers and scientists, and continuous research on gas warfare. Allowing for another big war in 1972, he considers that we should have soldiers who can pit brains against beef, and by science, on the roughly indicated analogy of gas, win a battle in " a day without a night."

Secondly, in the same spirit he advises the use of " General Tank." His tank will move forward in front of the infantry. It will offer a small target, and be gas-tight and bullet-proof. It will make twenty miles per hour. It will be invaluable in small wars, e.g. in a move from Pesshawur on Cabul. It will put gunnery out of date. Gunners against tanks will have to lay over the open sight and in respirators; for the tanks may bring up gas.

There will be swimming tanks, too, and tanks that can be carried in submarines; for wars in future on land and sea will be waged by machine power rather than by man power, though the writer wisely allows the value of the blare, the thunder, and the flash of cavalry in open warfare. He does not expect again the long war of attrition, in which cavalry has no chance.

Thirdly, he has downright views on aerial warfare. He regards sea-fighting as a prodigal method of war. He can picture a fleet of capital ships put out of action from the air by smoke, and toxic or non-toxic gas. In the future fleets will consist only of submarines or aeroplanes. The latter will move by hundreds, carrying thousands of bombs and bombing capital cities and other vital centres.

The airship will be useful for the carriage of supplies, as it is too slow and has too low a ceiling to come into action. It will be a mobile aerodrome for planes, which will attack at a great height and then swoop down and traverse with machine-gun fire bodies of enemy troops from van to rear, or open tanks of vesicant chemical, which will paralyse the traditional soldier.

Many critics will rush violently down to attack the gallant author, whose ideas are too fantastic and far-fetched for the man who after the Armistice exclaimed: " Now, thank God! we shall be able to get back to real soldiering."

The idea of the book may be fantastic; it may seem the creation of the pseudo-scientific novelist rather than of the practical soldier. But the author admits that he only adumbrates the lines on which future wars will be fought, and regards his work only as a stimulus to progressive thought. He does not tie himself to any cast-iron principle or practice.

His book will cheer up the civilian, particularly the politician, for whom it holds a promise of war that is cheap as well as humane.

The book is of great interest, but open to a great amount of criticism. Two criticisms especially strike the reviewer. Firstly, it begs the question that the rôle of war is to keep men alive. On this premise rest all the conclusions. But the philosopher, or any practical man, whatever his scientific bent, will find it hard to reconcile this premise with life, as we know it. The premise may be excellent humanity, but it is very poor science. You cannot draw an abrupt line between man and other animals, and deny, for instance, the common laws of life, and the instincts of pugnacity, fear, and acquisition, which make nations periodically spoil for a fight, in which blood must be let.

Secondly, if war could be fought and won in a couple of days, in a couple of weeks, or in a couple of months, could it be claimed that such a war had been fought " to a finish "? Would not your foe feel that he was beaten because his opponent had taken advantage of him by a sudden scientific trick? Life would be volcanic and precarious indeed with such methods of war, for one would be substituting endless rounds rapid for one continuous and conclusive bout.

MEASURING A NATION'S INTELLIGENCE

A Study of American Intelligence. By CARL C. BRIGHAM, Ph.D. A Foreword by ROBERT M. YERKES, Ph.D. (Humphrey Milford, Oxford University Press, 16*s.*)

In a play by Mr. Israel Zangwill which met with considerable success when it was produced, some years ago, America was pictured as a " melting-pot," wherein all

the nations of the world came together and were transformed into one harmonious whole. America had the property, it was suggested, of altering the new-comer, rounding off his corners, and producing an American—a distinct species, which nevertheless could be manufactured out of anything. It appears that Americans themselves seriously doubt this engaging theory, and the doubt gains expression in the book, which describes the results of a methodical study of the intelligence of recruits for the American army during the Great War. The tests employed were of two classes—one for more or less educated individuals who could speak the English language, and one for the illiterate, or those who know no English. The first series, in general, consisted of a number of questions, to which a selection of answers was provided, only one of which was correct. " How many legs has a Kaffir ? Two, four, six, or eight ? " is an example. The second series consisted of illustrations, containing some obvious error to which attention was to be directed, or of geometrical figures to be arranged in a given way. Throughout there was a very strict time limit.

Tests of this nature invariably amuse all save the psychologist, who is himself convinced of their value, and is gradually convincing others. They are widely used in this country, both as examination for Civil Service entrants and for industrial investigations, such as the selection of a vocation—draughtsman, fitter, turner, etc., for a young aspirant to a trade. The time limit, in a test of general intelligence, seems out of place, since it is obvious that many occupations tend to produce a type of mind more capable than the majority of a quick decision. Moreover—an objection which the author anticipates—some of the actual questions seem ill chosen. " Denim is an ' ad ' for a drink, revolver, flour, cleanser," is an example of a test which obviously would condemn a recent visitor to America who, wisely or otherwise, did not study the local press.

Still, just as any method of choosing a Parliament would be as satisfactory as any other in the long-run, so doubtless these tests answer their purpose well enough. They show, as the author says, that " according to all evidence available, American intelligence is declining and will proceed with an accelerating rate as the racial admixture becomes more and more extensive." This is attributed to the effects of immigration. There is a careful analysis of the intelligence of each immigrating nation. The order of merit is Holland, Germany, Denmark, England, Scotland; Ireland comes seventh and Poland last, nearly 7 per cent. of her candidates being below the mental age of eight. Of the negro recruits, 10 per cent. fell below that standard.

An interesting relation is shown between intelligence and length of stay in the country. The longer the stay, the more intellectual was the candidate. The explanations possible are—first, the melting-pot theory ; secondly, that only wise men stay in America ; lastly, that a better type used to come to that country than now does. We note that the French nation is not represented in the figures given ; no explanation—not even that no Frenchmen are wise enough to stay in America—is offered.

In a leading article in *The Times* for May 26, the same problem as it affects Canada is discussed. It appears from the work of Dr. C. K. Clarke, of the University of Toronto, that a most undesirable collection of individuals is being sent to that country by immigration societies. The question is certainly a difficult one. The individuals are objectionable, socially speaking, wherever they are. The world as a whole is none the better off for any effort to exclude them from any one quarter. Moreover, it is undeniable that Australia was colonised, in part, by convicts, even though convicts in those days were drastically punished for small crimes. None the less, Australians as a whole are among the finest physical types of men living on earth. No solution of the general problem is offered in this book ; but as a record of careful work, yielding most interesting results, it will repay serious study.

R. J. V. PULVERTAFT.

Books Received

(Mention in this column does not preclude a review.)

ARCHÆOLOGY AND ANTHROPOLOGY

The Oldest Letters in the World Tell Us—What ? By MRS. SYDNEY BRISTOWE. (George Allen & Unwin, Ltd., 5*s.*)

From Stone to Steel. A Handbook to the Cases illustrating the Ages of Stone, Bronze, and Iron in the Horniman Museum and Library. Second Edition, 1923. (Published by the London County Council and obtainable from P. S. King & Son, Ltd., or any bookseller, 6*d.*)

Tutankhamon and the Discovery of his Tomb. By PROF. G. ELLIOT SMITH, F.R.S., etc. (George Routledge & Sons, Ltd., 4*s.* 6*d.*)

MISCELLANEOUS

Flying Round the World. By MAJOR W. T. BLAKE. (Heath Cranton, Ltd., 12*s.* 6*d.*)

The Wheelwright's Shop. By GEORGE STURT. (Cambridge University Press, 12*s.* 6*d.*)

The Elephant Man and Other Reminiscences. By SIR FREDERICK TREVES, G.C.V.O., etc. (Cassell & Co., Ltd., 7*s.* 6*d.*)

Origins in Place-names. By an Ignorant Student. (London : Privately printed at the Chiswick Press.)

PSYCHOLOGY

Heredity and Child Culture. BY PROF. H. D. CHAPIN, M.D. (George Routledge & Sons, Ltd., 6*s.*)

Character and the Unconscious. By J. H. VAN DER HOOP. Translated by ELIZABETH TREVELYAN. (Kegan Paul, Trench, Trübner & Co., 10*s.* 6*d.*)

Self-healing by Auto-suggestion. Translated from the French of H. DOLONNE. (J. M. Dent & Sons, 3*s.* 6*d.*)

SCIENCE

The Wonders of the Stars. By JOSEPH McCABE. (Watts, 3*s.*)

I Principi della Meccanica alla luce della Critica. By GIUSEPPE CASAZZA. (Societa Editrice Dante Alighieri di Albreghi, Segats & C., L. 8.50.)

The Physiography of the McMurdo Sound and Granite Harbour Region. By GRIFFITH TAYLOR, D.Sc., F.R.G.S., etc., C. S. WRIGHT, O.B.E., M.C., and R. E. PRIESTLEY, M.C. British (*Terra Nova*) Antarctic Expedition of 1910–13. (Harrison & Sons, Ltd.)

The Natural History of Wicken Fen. Part I. Edited by PROF. J. STANLEY GARDINER, F.R.S., and A. G. TANSLEY, F.R.S. (Bowes & Bowes, 3*s.* 6*d.*)

Scientific Method. By A. D. RITCHIE. (Kegan Paul, 6*s.*)

The Phase Rule. By A. C. D. RIVETT. (Oxford University Press, 10*s.* 6*d.*)

Dreams of an Astronomer. By CAMILLE FLAMMARION, Translated from the French by E. E. FOURNIER D'ALBE. (T. Fisher Unwin, 10*s.* 6*d.*)

Petrology for Students: An Introduction to the Study of Rocks under the Microscope. By ALFRED HARKER, M.A., LL.D., F.R.S., F.G.S. Sixth edition, revised. (Cambridge University Press, 8*s.* 6*d.*)

The Properties of Engineering Materials. By W. C. POPPLEWELL and H. CARRINGTON. (Methuen, 28*s.*)

Six Great Scientists. By MARGARET AVERY. (Methuen, 2*s.* 6*d.*)

Correspondence

AXIAL ROTATION

To the Editor of DISCOVERY

DEAR SIR,

I was much interested in Mr. J. Marshall's letter upon Axial Rotation in the May DISCOVERY; it is a difficulty which I have often met with in others during my many years' experience of teaching astronomical science.

In the first place Mr. Marshall has not got hold of the idea of the laws that govern lunar rotation, because he states that it seems to him that the moon must turn the same face to the earth if its period be what it is, or 28,000,000 years.

The moon-earth system is one that is bound together by tidal attraction, and this same force is tending to drive the moon farther and farther from the earth, which state of affairs is gradually slowing down the earth, but at the same time is speeding up the moon. The day will therefore come in the dim future when those who are then living will see the other side of the moon.

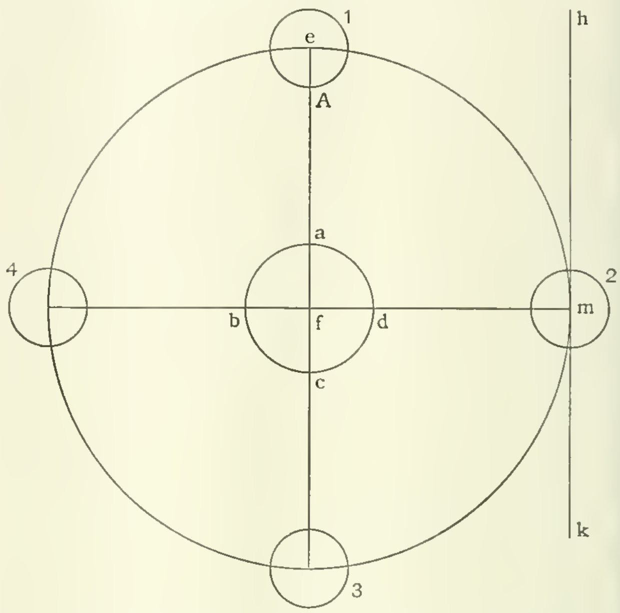
Mercury is almost certainly bound to the sun by the same tidal forces, but it is far more likely that Venus has a rotation period not very different from our own.

I think that by the aid of the diagram I have prepared Mr. Marshall's difficulty will vanish and he will see that in the various cases he mentions axial rotation is taking place.

We will first of all suppose the figure to be a section of the earth-moon system. Let the circle *abcd* be the earth, and let 1, 2, 3, 4 be four positions of the moon. Also let *e* be the centre of the moon, and *f* be the centre of the earth, and let A be a point on the moon's surface where the line *ef* cuts the moon 1.

Now if the moon simply revolved upon its orbit without rotation upon an axis, we see that the line *ef* will have shifted to *hk*, which must be parallel to *ef* when the moon arrives at 2. Therefore the point A will no longer be opposite the earth, but will be 90 degrees from the earth.

Now we know from observation that this is not the case, the point A must be opposite the earth whenever the moon may be upon its orbit, and therefore A is not on the line *hk*, but is on the line *mf*; and thus the moon must have rotated through 90 degrees on its own axis, and so on for any other position.



We can thus show that a rotation of 180 degrees has taken place when the moon gets to 3, and 270 degrees when the moon arrives at 4; and therefore one complete rotation when the moon arrives back at 1.

The reason why a lunar observer at A will not see the earth rise and set is not because the moon has no rotation, but because the revolution and rotation are equal, owing, as we said above, to tidal attraction.

Now let the diagram illustrate the seconds dial of a clock, and it can be shown that if the disk did not rotate as well as revolve, it would break away from the hand.

In the diagram the hand is at 30 seconds when the disk is at position 1; and therefore the pivot of the hand is at *f* on the line 3*cfaAe*.

By the time the hand gets to 45 seconds the point A is on the line *bfdm* and not on the line *hmk*; therefore A has rotated through 90 degrees; and so on for any other position.

Mr. Marshall can employ the same diagram to work out his problem of a cricket ball on a string, and also the ball placed at the end of a railway turntable.

I am, sir, yours, etc.,
JOHN L. A. SILLEM.

12, ROTHSAY GARDENS,
BEDFORD.
April 30, 1923.

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Editorial Notes

THE idea of a "lost Atlantis" has for several centuries fascinated mankind and attracted its more imaginative members to weave fantastic legends about some once beautiful continent inhabited by a highly civilised people before it sank into the waves of the Pacific thousands of years ago. In the July number of DISCOVERY we published an account of a new theory about the structure of the earth.[1] The theory is that of a German geologist, Kober, and in one sense is a development of Professor Wegener's new theory of land and continent formation. Kober puts forward the idea that in the process of cooling the earth's crust has come to consist of large, solid blocks of matter moving gradually through a softer layer. The large blocks meet each other, the softer layer being pushed up in between them during the gradual process of contact. In this way mountain masses and high land are thrust up above the sea level, only to subside again millions of years later as the blocks beneath corrode owing to their pressure against each other. Such is the theory in bald outline. Though it must be accepted with considerable reserve and is certain to provoke much criticism, it gives a plausible explanation of some quite recent earth disturbances—of the strange fate, for instance, that appears to be overtaking Kamchatka and of the earthquakes last November along the coast of Chile.

* * * * *

The disintegration of Kamchatka, that vast north-eastern peninsula of Asia, 780 miles long and at its widest part 280 miles broad, appears to be taking place at enormous speed. An article in the *Daily News* in June of this year mentioned that "from the beginning of February till April 16, no fewer than 195 shocks were recorded, gradually increasing in intensity until houses collapsed and huge floes of ice from the ocean were thrown far inland. On April 18 a particularly violent shock occurred, accompanied by a tidal wave. . . . The most extraordinary feature recorded is that the water of the Kamchatka River has vanished into the bowels of the earth."

* * * * *

Kamchatka, according to Kober, is part of a geologically new, and therefore unstable, orogene zone; the west coast of South America, including Chile, has been similarly classified by him. This brings us to the borders of our "lost Atlantis." Whatever caused the disappearance of this huge land mass, and whether we accept Kober's theory of subsidence owing to corrosion as a reasonable explanation, certain it is that Atlantis did once exist. We have not only geological, but also botanical and zoological, evidence in support of its existence. It was more than an island, and it stretched from Brazil to Australia, even including a vast portion, if not the whole of, Africa in its extent. Geologists call it Gondwana Land and calculate that it existed some 20,000,000 years ago! It is natural that that portion of this ancient continent which lies beneath the southern waters of the Pacific should attract the greatest interest, for in the scattered archipelagoes of Polynesia we still have the remains, the mountain peaks, as it were, of the "lost Atlantis."

* * * * *

Thorough investigations of the Pacific will take place in the near future, and three scientific expeditions have already been organised with these purposes in view. The Natural History Department of the

[1] See p. 171, *The Structure of the Earth*, by O. H. T. Rishbeth, M.A.

British Museum despatched an expedition, under the leadership of Captain George H. Wilkins, a member of the recent *Quest* Expedition, to Australia last February. This expedition will make as exhaustive a collection as possible of the mammals and flowers of the island continent. Such a collection is certain to throw a great deal of new light on the past land-bridges between Australia and the larger continents of to-day.

* * * * *

The effects of the Chilian earthquake on the ocean bed of the Pacific off the American continent are to be investigated by an expedition under the auspices of the Carnegie Institution of Washington, and warships of the United States Government will be employed. The area to be covered lies off the Pacific Coast of America, between San Francisco and the Mexican boundary, and soundings will be made over some 10,000 square miles of ocean.

* * * * *

Last January a very interesting new society was formed at Burlington House by a meeting of men of science—the Scientific Research Association. No doubt we shall be in the position of bringing the activities of this association before our readers from time to time, but for the moment we may mention that one of its first decisions was to organise an expedition to start this summer for the South Pacific, where scientific research of various kinds is to be carried out, and the effects of the Chilian earthquake in this direction are to be examined.

* * * * *

The likelihood of any further discoveries of land in the South Pacific and the Southern Ocean is very small; the voyage of the *Quest*, admittedly hampered by engine trouble and ill-luck, resulted in no "finds" of mythical lost islands. The world which we inhabit is becoming commonplace; we cannot, like our forefathers of several centuries ago, look forward to the excitement of some expedition revealing new lands and new peoples in unknown quarters of the globe. From the early days of Greek civilisation and onwards to Elizabethan times, there was always the possibility present in men's minds, not merely of discovering new lands, but of discovering in those lands communities enjoying a life of greater freedom and happiness than that to which they were accustomed themselves. Nothing could have been more natural than that imaginative men in the past, standing on the shores of their respective countries, looking out across great wastes of water, and feeling tired of the circumstances of life which they and their fellows had to endure, should have conceived of distant Utopias beyond the rim of the horizon—the Hesperides, the Isle of Avalon, the Blessed Land of the Dead, the Elysian Fields, the Fortunate Isles. Even Francis Bacon, who never let his ideals endanger his safety and comfort, wrote of a *New Atlantis* where science and the arts had been brought to a high degree of efficiency.

* * * * *

For imaginative power, breadth of outlook, and bravery of vision, the *New Atlantis* does not bear comparison with More's *Utopia* written a century earlier. This wonderful book, of which a new translation has just been published,[1] constitutes a landmark in the progress of idealism even greater than St. Augustine's *De Civitate Dei* and Plato's *Republic*, to which it owes much of its inspiration. It paints the picture of a country inhabited by a true commonwealth in which there is no private property and "though no man has anything, yet all are rich," in which science and philosophy have come into their own, where war is regarded "with utter loathing," and where selfish aims and ambitions obtain no reward.

* * * * *

In the clash between Capitalism and Labour to-day we are naturally apt to think too much of present "wrongs" and immediate "dangers." The ideal of a state in which health, happiness, beauty, and progress of knowledge shall be ensured is sacrificed to political ideals which should be subservient to it. More important than the destruction of systems of government is the destruction of disease, slum areas, outworn traditions, ignorance. Science in all its branches is working towards establishing a Utopia on this earth. Last year will remain memorable as the year in which man found out how to allay, if not entirely to cure, the disease of diabetes; this year he has discovered a vaccine which may sooner or later rid the world of consumption; this year, too, sees the start of the most determined onset on cancer that has ever been attempted. The sciences of anthropology and psychology are giving us a knowledge of the workings of the individual mind and of the behaviour of "groups" of individuals, which is being felt directly or indirectly in social life and traditions all over the civilised world.

* * * * *

A brilliant forecast of what our world may be like several thousand years hence is given in Mr. H. G. Wells's *Men Like Gods*.[2] Though his Utopia is placed

[1] *More's Utopia.* Translated into modern English by G. C. Richards. (Oxford: Basil Blackwell, 3s. 6d.) Earlier translations from the original Latin have been characterised by a dullness of language, which has rendered them almost unreadable. This new translation by a Fellow of Oriel College, Oxford, is admirably lucid, though it adopts to a certain extent the written English of More's own period.

[2] Cassell & Co., 1922.

in another planet, the allegory is obvious. The planet into which the "Earthlings" are caught up by the exploit of two Utopian scientists is one in which the "Age of Confusion" has been left behind several thousands of years ago. In this planet long-distance travelling is done in silent flying machines; speech and conversation are carried on by means of transmitting thought from mind to mind, languaged difficulties being thus avoided; labour-saving methods have reduced heavy and laborious work to its minimum; war and disease, injustice and fear, have been completely banished; the inhabitants have set their minds and bodies free to probe into the universe outside their own world. Into the narrative and details of this book we cannot go; the "Earthlings" introduce disease and war into it, but both are combated successfully and, like Adam and Eve, the "Earthlings" are sent back from this paradise to their own planet. Many an "earthling" will throw mud at Mr. Wells's Utopia, and scientists may not agree that all its exploits in chemistry, physics, and engineering will ever be feasible. But it is a great book all the same, for it contains a striking analysis of our present Age of Confusion, and its forecast of the future is a triumph of the human intellect. We believe that we are struggling slowly and painfully out of an Age of Confusion, and that science, in the widest meaning of the word, is already in the vanguard. Atlantis may never emerge before the eyes of adventurers in the Pacific; we are all adventurers, and Atlantis is gradually—very gradually—rising in our midst.

News of the Month

TWO NEW VOLCANIC ISLANDS

Of the many instances of earth disturbances this year one of the most extraordinary is the recent formation of two small volcanic islands in the China Sea. *The Geographical Journal* for July publishes reports on these remarkable phenomena. The first report was written by Captain Horikawa of the *Wakasa-Maru*. During the voyage of this vessel between Hong-Kong and Singapore the peak of Pulo Cecir de Mer "bearing 298 degrees at a distance of $7\frac{1}{2}$ miles" was passed at 3.20 p.m. on March 2. A long range of white smoke was noticed (ascending from the sea) by the second officer. The captain altered his course in the direction of the smoke, thinking that it was a tank-ship on fire; but on ascertaining that the phenomenon was due to volcanic action, he put his ship back on her original course at 5.45 p.m. and passed the smoke at about $3\frac{3}{4}$ miles off. "The sea surface in the neighbourbood of the volcanic action was much disturbed, but could not be well seen. A cloud of grey vapour rose to some height, and made a long range of clouds in the blue sky extending to the horizon to leeward. At intervals a large mass of gas appeared above the disturbed surface of the sea. Sea-water with ashes fell from it on its first appearance, and it then ascended with great speed, growing larger as it rose and balloon-shape, becoming eventually like a large mass of cumulus cloud and following the range of clouds which had been blown to leeward. The height was estimated at 7,000 feet."

As a result of Captain Horikawa's report, H.M.S. *Carlisle* made a passing examination of the sea in the region of the disturbance during her voyage from Singapore to Mirs Bay. This took place on March 8, that is, six days later than the first sighting of the phenomenon; and Captain Dickens, R.N., after sighting the column of vapour, closed in nearer and discovered that an island of a horseshoe shape, rising at the W.S.W. end to a height of about 80–100 feet, had been formed.

Since Captain Dickens's report an Admiralty Notice, based on a report from H.M. Surveying Ship *Iroquois*, dated May 13, has been issued. On this date the volcano was still active and the island had grown to a height of 97 feet. Moreover, a second volcanic island had been formed 2 miles south of the first; this was still in eruption and about 1 foot in height. A shoal-bank, 12 fathoms under water, was also discovered a mile south-east of the first island.

One of the most interesting points about these volcanic activities, as *The Geographical Journal* observes, is that they are "a long way removed from any recent volcanoes." The whole phenomenon raises many questions, such as, "Will these islands subside into the sea again or, just as likely, will they cool down and will it be possible to land on them?"

That the surface of the earth is in a more disturbed condition than it has been for a great number of years there is no doubt. The disturbances off the coast of Chile last year, and the strange phenomena in Kamchatka, widespread earthquakes in China, and the eruption of Etna, all in the first six months of this year, must surely in some way be related to one another.

THE CINEMA IN THE UNITED STATES

The enormous growth of the cinema industry in the United States is amply illustrated by statistics recently issued by the Motion Picture Directory of New York. They reveal the fact that there are approximately 18,000 moving-picture theatres in the whole country, providing a total seating accommodation of from 8 to 10 millions. It is estimated that at least 50,000,000 Americans attend the cinema each week, and that sometimes attendances rise to 15,000,000 a day.

We believe that the day is not far distant when the Cinema and Wireless Broadcasting will usurp the present position of the daily press in supplying the public with its news. Experiments are also on foot for reproducing films by wireless. We can only hope that both industries will realise their enormous power over the minds and emotions of humanity and attempt to follow more conscientious principles and interpret news with less bias than many of the present newspapers existing in this world.

The Transmutation of the Elements

By A. S. Russell, M.A., D.Sc.

Student of Christ Church, Oxford

ALCHEMISTS are still alive. My quarrel with them is that they are mostly men of one idea, the idea being a wrong one. For some years I have taken an interest in their exploits, and recently, when I analysed the various stories that have come to me, I was struck with their great similarity. It is as though the same alchemist bobbed up from time to time at different places with the same story, but actually this is not so ; it is the same idea that in different places and at different times during the last twenty years has inspired different men. To make gold out of lead is merely one of those conventional methods of raising the wind which include the confidence trick, the Spanish prisoner story, and the poisoning of insured relatives with white oxide of arsenic. I do not say that our conventional alchemist is necessarily insincere or even wilfully tells untruths. Occasionally he is quite sincere, or, as it has been described to me, " candour and innocence are reflected from every pore of his body." He is merely under a delusion, and he wishes to share this delusion with his fellows, particularly if they be journalists or economists, best of all if they be company promoters or politicians. It is hardly fair to ask him to discuss the matter with a scientist. It disturbs him. He is apt to get rattled. Often his apparatus for doing the job breaks down just before the scientist arrives. It is curious that a scientist should have such a unique effect.

Two Gold-makers

It is unfair to alchemists to talk of them in this way without saying, on the other side, that on two occasions they have demonstrated their system before the eyes of a scientist. On the first occasion the alchemist made mercury from lead, and after resting from this truly Herculean feat, made gold from mercury. The lead and the furnace to melt it were provided for him, the mercury, it was discovered, came from a hip-pocket, the gold from a sleeve. On the second occasion, which took place after the death of the first alchemist, a mixture of gold and lead was actually prepared from carefully purified lead under strict conditions to avoid the results of prestidigitation. (The alchemist was clad in a bathing-suit.) But even he insisted on stirring the molten lead with a steel rod, and afterwards the rod was found to be hollow. The ingenious man had had it filled with gold dust and closed with wax, so that the gold passed into the lead without difficulty soon after stirring had begun.

If one could make gold genuinely out of lead or anything else, there would be no occasion to adopt the tactics of the alchemist—in trying to float a company or to sell the patent to a government, etc.—the gold-maker has merely to continue making the gold, and soon he will acquire all the wealth as well as all the scientific fame he can desire. He needs no one to help him. But actually, unless present-day science has gone right off the track, no one can make gold in bulk or even in quantities that can be seen or weighed. Yet science does not declare that transmutation is impossible ; quite the contrary. But in showing that transmutation is not only possible, but actually going on in nature, it reveals how absurd, or at the best how distorted, are the usual ideas and claims of alchemy.

The disintegration or transformation of atoms that is known as transmutation is most conveniently described under two heads : (1) transmutation which occurs spontaneously in nature and which is confined to the very heaviest elements, and is so far uncontrollable by man ; and (2) artificial and controllable disintegration, due to the experimental skill of Sir Ernest Rutherford, of Cambridge, which is confined at the time of writing to a few of the lightest elements.

Spontaneous Transmutation

I pass now to the first part of the work, dealing with genuine atomic disintegration, i.e. to radio-activity First of all, what is meant by disintegration ? Let me say a few words about the atom in reply. An atom is supposed to be a structure about 10^{-8} cm. (about a hundredth of the millionth part of an inch) in diameter, having at its centre a tiny thing called the nucleus. The nucleus consists of both positive and negative electricity (with, however, a great deal more of the first than of the second, so that it is positive) ; it is only about 10^{-13} cm. in diameter (the hundred-thousandth part of the diameter of the atom), and yet it contains practically the whole of the mass of the atom. Round this nucleus are spaced many single charges of negative electricity called electrons. The heaviest atom that is known, the atom of uranium, has ninety-two electrons ; the lightest, that of hydrogen, has but one. It is the nucleus, not its surrounding electrons, which is the seat of atomic disintegration. Alter the nucleus, if you can—it is extremely difficult to do so, but not impossible—and you have brought about transmutation. Now, this tiny nucleus has a structure about which something is known. It appears to consist of an assemblage of the nuclei of

helium and hydrogen atoms, and of certain electrons. The number of helium nuclei may be small or great according as the atom is light or heavy, but the number of hydrogen nuclei is supposed to vary only from 0 to 3. But we need not discuss these speculations further. The essential point is that the nucleus of a radio-element may expel part of itself in two ways: (1) it may expel the nucleus of a helium atom—thereby emitting energy (for the helium nucleus weighs 4 and travels at about 10,000 miles per second) and thereby also becoming transformed or, if you like, transmuted, into the nucleus of an entirely different element; or (2) it may shoot out an electron, which has, however, much less energy than a helium nucleus (because it has "almost no weight"), and after so doing become an entirely different nucleus. Now, it is found that whenever a helium-nucleus is emitted by a radio-element, the new element formed lies *two* places *lower* than the old in the ordinary way in which elements are arranged, and whenever an electron is shot out the new radio-element lies *one* place *higher*. This rule is found to hold perfectly in radio-active transformations, from the heaviest radio-elements down to the inactive element lead. There is no reason to think it would fail to hold, therefore, for any body which might be compelled to expel a helium nucleus or an electron. Let us now arrange the elements from platinum to lead in the order of their atomic weights. This order runs platinum, gold, mercury, thallium, and lead. If lead could be induced to expel a helium nucleus, the resultant atom would be mercury (two places lower); by a similar transformation platinum would arise from mercury. If, finally, an atom of platinum could be induced to expel from its nucleus an electron, gold (one place higher) would result.

But radio-activity teaches that the essential point about this kind of transmutation is the energy produced and not the body produced as a result. It is the energy alone that is obvious and important. The gold or other bodies produced would hardly have the importance even of by-products. A man looking for gold as the result of the transmutation of lead is more foolish than one who cannot see that the importance of an internal-combustion engine lies in making a motor-car go, because he is intent on studying the waste gases shot out by the exhaust. A gram of radium with its products gives out 130 units of heat-energy every hour *continuously*; yet radium is a very rare element, and its rate of transmutation is actually very slow. Imagine the energy of radium if we had pounds of it, and if its rate of transmutation could be speeded up at will. How much greater would be the energy evolved by common elements like lead or mercury, procurable by the ton, if they could be made to do by artifice what radium does spontaneously! But so far the heavy elements cannot artificially be made to disintegrate, but experiments with a few of the lighter ones show that the process, although extremely difficult, is to some degree possible, and these will now be described.

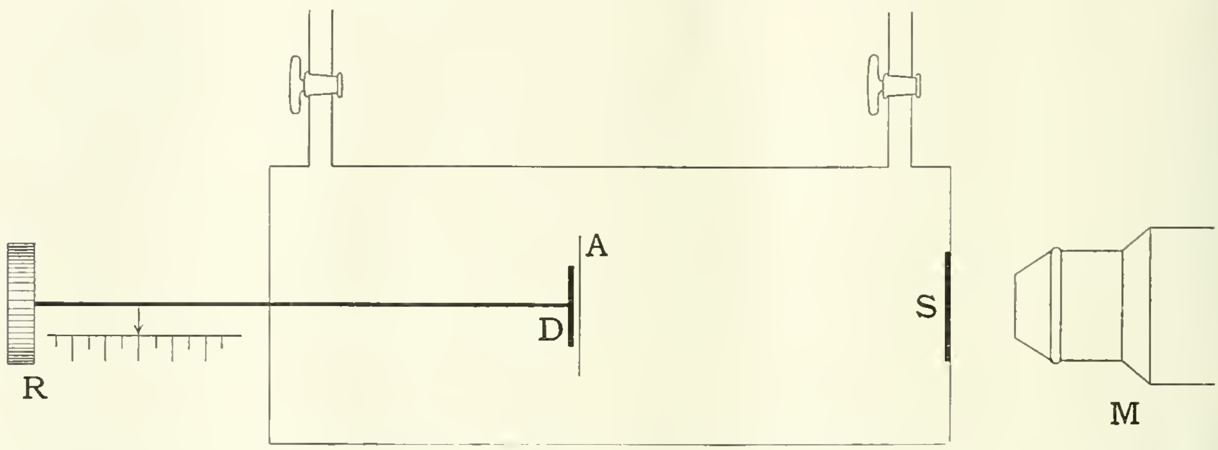
Artificial Transmutation

These experiments have been done by Sir Ernest Rutherford at Manchester and at Cambridge, and the method in outline is this. The nuclei of different atoms are bombarded by swift α-particles (which are helium nuclei) from the radio-element radium C; a minute fraction of the nuclei of certain elements is found to be ruptured by these particles and a small portion of a nucleus is broken off; these broken-off pieces are examined by an ingenious device and found in all cases to be nuclei of hydrogen atoms.

The nucleus of an atom, it has been mentioned, is so small with respect to the atom itself that if the latter were magnified to the size of an ordinary market-town, the former would measure little more than a foot every way. It is obvious, therefore, that to smash up the nucleus—which alone insures artificial disintegration—not only is a projectile of some kind necessary, but particularly accurate shooting must be done. Since there is no means of taking aim or correcting fire, the only means of hitting the target is to fire a very large number of projectiles. A few then have a chance of hitting.

The α-particle from radium C is a helium nucleus with a mass of four units, shot out with a velocity of about 12,000 miles per second. This is, of course, a very tiny mass, but mass for mass it has about four hundred million times the energy of a rifle bullet. When it strikes a screen of crystallised zinc sulphide it emits a flash of light, a scintillation, which may be observed through a low-power microscope by eyes well rested in the dark. The light seen thereby is known to be due to the collision of a single nucleus with the molecules of the zinc sulphide screen. It is found, however, that, if the screen be moved away from the source of α-particles farther than 7 cm. in air, no light due to these particles can be observed. That is because 7 cm. of air offers such resistance to the passage of these nuclei that they lack sufficient energy to cause a flash of light. If next these nuclei are compelled to force themselves through a substance much denser than air, say a thin sheet of magnesium or of paper or of mica, they will naturally be stopped much sooner, but they will go a distance before they are completely stopped, which is roughly inversely proportional to the sheet's density. Rutherford did his first successful experiments with nitrogen, but a later experiment with aluminium is more convenient

to describe. The apparatus he used is shown in Fig. 1. He found that if a thin piece of magnesium foil, equivalent in stopping power to 7 cm. or more of air, were interposed between the source of α-particles and the zinc sulphide screen, on which they could be detected, the screen was quite dark. This is, of course, an old result, and what was to be expected. But the new result was this, that when aluminium foil was substituted for the magnesium many scintillations appeared on the screen, and further examination showed that the particles producing these scintillations were not α-particles, but particles that could travel as far as 90 cm. in air before they were completely stopped. They were proved to be hydrogen nuclei which must have been broken off from those aluminium nuclei which had had a head-on collision with the α-particles directed against them. The number of aluminium nuclei struck in this way is relatively extremely small. Rutherford has calculated that only about two α-particles in every million get near enough to the nucleus to be able to break off a piece of hydrogen, although each passes through about a hundred thousand atoms of aluminium before it is stopped; that is to say, there are only two really successful hits in a hundred thousand million shots.



In a glass tube which may be evacuated is inserted a disc *D* containing the body which expels α-particles. It can be brought nearer *S* by the screw *R*. *S* is the screen which emits light when struck by the particles from *D*. The flashes are observed by looking through the microscope *M* focused on it. *A* is a movable screen placed in front of *D* so as to be bombarded by the α-particles.

Elements which may be Transmuted

Of the elements experimented on in this way, six only have been artificially disintegrated. They are boron, nitrogen, fluorine, sodium, aluminium, and phosphorus. These bodies have atomic weights expressible by the formulæ $4n \times 3$ or $4n \times 2$ where n is an integer and, since 4 is the atomic weight of helium, their nuclei may be regarded as made up of helium nuclei with 3 or 2 attendant hydrogen nuclei. It is probably the latter which are ejected when the α-particle strikes. The elements whose atomic weights are less than 32 but not expressible by the above formulæ, do not appear to be disintegrated by α-particles, and *all* elements with atomic weights greater than 32 are similarly inert. In the case of aluminium, which shows the phenomenon best of all, it has been shown that the energy of the liberated hydrogen is greater than that of the liberating α-particle; which means that some of the internal energy of the atom has been tapped. This liberation of internal energy occurs, as has been mentioned, spontaneously in radio-active bodies, but it is important to have direct proof of it from those elements artificially disintegrated.

Let me say this again in different words. Of the eighty-seven known chemical elements, six at present have been artificially disintegrated and four of these are very common elements. The disintegration or transmutation appears to be quite genuine. In all six cases the piece knocked out is the element hydrogen, and the piece that remains becomes a new element. In some cases there is energy "tapped" from the source of internal energy of the atom. But the only means of procuring this type of transmutation artificially is the high-speed α-particles emitted by radio-elements, and these are and always will be among the very rarest of substances. So that, although all these processes are of great interest to the theoretical scientist, there has been just enough done to encourage the exploiter of scientific knowledge, the man whom people describe so glibly as about to tap the hidden forces of the atom, if not to hope, at least not to despair.

Conclusion

To sum up in a few sentences. The dream of the

alchemists and the popular ideas of to-day concerning the transmutation or artificial disintegration of elements are in many points wrong, but they are not altogether wrong. There is a germ of truth in it all, but it is truth distorted. Emphasis, for example, has been put on the gold, and not on the thing many times more important, the liberated energy. In radioactivity we see transmutation going on among the heaviest elements with liberation of relatively very large quantities of energy, but as these elements are among the rarest of all, the whole business is really on a very tiny scale only. Also it is spontaneous; it exists of itself; we cannot accelerate it. Some of the lightest elements, however, have yielded to the attacks upon them, and are in fact disintegrated at the will of the experimenter. But this process can be carried out, from the nature of things, to a very small extent only. It can be proved that the disintegration is real, and that the internal energy of some atoms may be tapped; but although a beginning has been made, it would at present appear unlikely that the process may be so extended as to do things on what is known as a commercial scale. The main thing, however, is that a real beginning has been made, and the rest may be very safely left to the future.

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Vehicles and Routes of Thought

By T. H. Pear, M.A., B.Sc.

Professor of Psychology in the University of Manchester

There are unfortunates for whom Windermere is separated from Keswick by twenty miles of a first-class road and fifty minutes of other people's dust. For the lucky ones, there stretch between these towns a hundred miles, a week or more, and ways infinitely various, blessedly unclassable and consistently dustless. What his route may mean to an aviator who flashes over this region in ten minutes, I neither know nor care.

The relevance of this introduction lies in the fact that persons whose interest is merely to transport themselves from one spot to another seldom speculate overmuch about alternative vehicles or routes unless the former let them down or the latter become blocked. But a snowstorm, a strike, or a flood will instantaneously coerce their interest in both these subjects. Moreover, your rock-climber, walker, motorist, and aviator, in their conversations about a hilly district, are clearly, from the subjective or psychological point of view, discussing different and incommensurable things.

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Now those peculiar processes of travel through reality which we call thinking are facilitated by vehicles of various kinds. Prominent among these are mental images, and not, of course, visual images alone. For the present purpose it will be assumed that every kind of sensation we have had is capable of leaving behind it the material potentiality of its revival in the form of an "image," visual, auditory, tactual, and the like. Words, which are schematic images heavily charged with meaning, are the chief carriers of some people's thought, and "conscious attitudes," or *Bewusstseinslagen*, the wraiths of gesture-language, the timid, incipient contractions of muscles which under the suns of Sicily or Los Angeles might thaw out into full-blooded gestures, are the natural bearers of others. In some people, a train of thought, if it lasts long enough, may command all these vehicles.

But just as travel has purposes of which carriages are mere instruments, so in people's minds meanings express themselves more or less successfully and completely through these images and bodily sensations. And there are psychologists who hold that in highly developed minds meaning may function in its own right, that "imageless thoughts" exist; that they are not "fancies that broke through language and escaped," but thoughts which, as yet untrammelled by language, living in a primitive nakedness, would be cramped by clothing, even if it were the lightest vestments of a poet's imagery. Other psychologists, while accepting the empirical data upon which this belief is founded, would urge that before embracing it we should explore exhaustively every aspect of the possibility that these gossamer meanings are carried by suitably delicate contractions of those muscle-groups subserving speech, gesture, and emotion.

But the last ten years have seen a fairly general mobilisation of psychologists for immediately practical uses. As a result, since psychologists are still, comparatively speaking, a small band, there has been a certain aversion to this inherently challenging problem of theory. We must now turn away, too, but for a reason more simple, obvious, and perhaps more convincing than those which have led to this deviation of interest.

The Varying Manner in which Individuals Think

The main purpose of the present article is to express

a view which has already been elaborated elsewhere,[1] but to substantiate it further by evidence from other quarters. It is that imagery, so far from being the mere scaffolding of the thought-structure, eventually to be knocked away and destroyed, leaves a permanent impress, in myriads of ways, upon the thinking of its possessor. Perhaps the very elect may succeed in shaking off its limitations, though this is far from certain. What is certain is that many persons live for ever boxed up in their own image-world, seldom or never suspecting that their best friend lives in another. Just as painting, sculpture, writing, music, dancing and acting are inevitably limited by their media, it would be surprising if a man whose imagery was for the most part visual should look at life in the same way as one whose chief memory-material was auditory. That these two friends use the same words does not invalidate this statement, for nobody can expect them continually to express themselves in pictures and symphonies, or even in sketches and trills. But for both of them words are often but sorry makeshifts. They would probably agree that, whether or not speech was given us to conceal our thoughts, it usually distorts theirs.

But at this point a predominantly verbal thinker is sure to speak up for his class. For him at least, he will insist, words are seldom reach-me-down, standardised garments for meanings which gawkily project from them on all sides, but words clothe his meanings as silk yields to every fold of the body. For him, words often *make* meanings, as the annual ukase from Paris appears to mould feminine anatomy, or as fashions in shoes actually do. Much more is the man who thinks verbally likely to say in praise of the power of words and, unless he be exceptional, he is sure to assume that others are like himself. It may well be that he thinks *in* rather than *with* words: that often, when he thinks, words and very little else besides are in his mind; that he has a large and easily accessible stock of "ready-mades" in his mental wardrobe, or is, perhaps, less finicky in his choice of garment.

It must not be forgotten that persons also exist with predominant imagery from other sense-spheres; imagery of bodily movements other than those mediating speech, of touch, of taste and smell, and of organic sensation. Their mental worlds have just as much claim upon our respect as those of the visual and auditory thinkers,[2] though certainly they do not get it. But the rest of this paper must be given up to the description of some peculiarities of the predominantly visual thinker; the joys afforded him by his vehicles and his routes of thought, and the straits to which he is often reduced by them both.

The following lines are based upon many conversations with different persons in laboratories, in hospitals, and in ordinary life. They are intended to do no more than to record provisionally some abilities and disabilities of certain persons, and to inquire into the relation between these peculiarities and the different kinds of imagery which play a predominant part in their thinking. The investigation has not been deep or wide enough to warrant the attribution of these abilities and disabilities, occurring in a "strong" visualiser or verbaliser, exclusively to his particular type of thought-imagery. There seems, however, to be evidence, both internal, from the subject's introspection, and external, from the observation by others of his behaviour, that such peculiarities are very potent factors in the thought-apparatus.

It will be obvious to a reader who is familiar with recent developments of psycho-analysis that another method of classifying individuals, which maybe cuts across the distinction of image-type, demands notice. It is founded upon the directions in which the thinking, feeling, and acting of the subject are usually turned; whether towards the outer world or towards his own personality; it is the distinction, by which some psychologists divide human beings into two classes—the introvert and the extrovert.[3] But how far early differences in predominance of imagery may be the cause or the effect of the different ways in which these two types think, nobody knows at present.

With these provisos, then, I venture here to put on record the following tentative beliefs about certain persons in whom visual and verbal imagery respectively are predominant. They will be termed visualisers and verbalisers. In giving them these names, it is not implied that the visualiser cannot think in words nor that the verbaliser cannot think in pictures, and it is recognised that these descriptions may not prove to be true of all visualisers and verbalisers. But I mean that in both of them the vast majority of their thoughts use one rather than the other of these modes of development. A verbaliser may either mentally "see," "hear," or "speak" his words. But the type described in the following paragraphs usually employs, or is employed by, what is termed vocal-motor imagery, often blended with imagery of the sounds of the words.

The Visualiser and the Verbaliser

When remembering, the visualiser attributes special importance to the appearances of persons and things; possibly even more than when they were actually present in experience. This sensitivity to the look

[1] *Remembering and Forgetting*, London, 1922, pp. 205–31.

[2] Cf. Helen Keller's account of her blind-deaf life in *The World I Live In*.

[3] Cf. C. G. Jung, *Psychological Types*.

of things seems to make him more susceptible to influence by the written (and especially the printed) words of others than by their spoken words. He is a bad listener, finding it difficult to comprehend a scheme when it is orally explained, and easy to grasp it from a printed explanation. He seldom remembers the actual words used in his own conversation or in that of other people, and wonders that others can do so. He seldom talks to himself, either loudly or quietly, and when things go wrong he probably gets a subnormal amount of satisfaction from the use of expletives, unless they be new and loaded with picturesque imagery.

Speech about any matter which requires directed thought is, on the whole, slower and more unsatisfactory for him than for the verbaliser. Writing may be for him a pleasure or a pain. If pressed for time, it is an uncongenial task to describe or to express in writing something about which he really cares, for he knows that the words will fall short of, or overlap, his real meaning. With plenty of time before him, it may be amusing and challenging to discover the words which will most neatly fit what he wants to say. To have to write in a hurry about a serious matter is like opening a bud before its time, and he will usually offer an inexhaustible series of perfectly cogent reasons why such writing shall not be attempted. This does not prevent him, of course, from using words or phrases as gestures of politeness, as one may do at the end of a letter. But I venture to suspect that the visualiser may be less easy to hypnotise than the verbaliser by the sonorous phrase in politics, or the ancient and respectable in science. (It may be well to except from this statement some verbalisers who have had a philosophical training.) Perhaps for the verbaliser the platitude is a little more impressive, a little less likely to be seen through, just as the platitude's pictorial homologues ; impressive tailoring, or an actress's pretty professional smile, may have similarly paralysing effects upon the visualiser's thinking.

To many an orator's rumbling stream of words, as round and as alike as beads, connected by an almost imperceptible but cheap string, he is specially impervious, unless they happen to evoke vivid pictures. Even then he may not welcome them, preferring to make his own, like many of his kind who object to actual pictures which profess to illustrate a novel. He often finds it difficult to keep pace with a speaker who employs abstract and general terms. This is sometimes because his simple arithmetical thinking is easily outstripped by the speaker's comprehensive algebraic processes. At other times, perhaps, he is hindered by the results of applying this apparently satisfactory algebra to concrete cases and finding that it is true only of imaginary quantities.

It may be, too, that a person of this type, when he falls sick or is otherwise in trouble, is less easily and completely comforted by the spoken word, uttered either by another or by himself, unless, for special reasons, often connected with visual factors, the word is extraordinarily impressive. This might explain some interesting observations. An intelligent patient, during the course of a severe nervous trouble, was greatly troubled by pseudo-hallucinations [1] of a distressing kind, which vanished after their sources had been traced by analysis. During an interview with the doctor, the patient complained that, although on leaving the consulting-room he invariably felt better for an hour or so, after that time the meaning of the conversation which had relieved him entirely vanished, and the time seemed to have been wasted. One day a colleague suggested that this might be connected with the patient's predominant visual imagery, and that therefore it might be worth while to try the effect of writing down for him the gist of the hour's conversation. This was done. The patient then reported that whenever one of these specific worries arose he would read the slip of paper which summarised the therapeutic conversation about it, and feel immensely relieved. One night the doctor had attempted to lessen one of the patient's serious anxieties by a simple explanation of the brain's functions, illustrating his remarks by a sketch of the cerebrum. When, that night, the hallucination appeared in the darkness, there spread over the centre of it an image of the brain-diagram, which reassured him and brought him great comfort.

Though this is an extreme case, it illustrates the way in which spoken words may fail to affect certain individuals, not because the words are not understood, but simply because their appeal is in a medium which is under-developed in these particular persons.

Auto-suggestion and the Verbaliser

It might be profitable to discover how far auto-suggestion, in that form at least which is recommended by M. Coué, may owe its success to peculiarities in the individual's imagery. Certainly one cannot decide from theory whether a person who habitually makes up his mind by means of words, using muttered or sub-vocal phrases as slips from which to launch his actions, is likely to find autc-suggestion more or less effective than the man who seldom or never "pushes off" from a word. For the latter, auto-suggestion might conceivably be very effective if the doctor's hetero-suggestion were so powerful as to make the patient adopt this, for him, violently unusual behaviour.

[1] Hallucinations the origin of which is attributed by the patient to his own mental processes, no objective reality being attached to them.

That auto-suggestion is successful to different degrees in different persons is well known, and it does not seem unlikely that different kinds of imagery may play a part in bringing about these varying effects.

That neglect of differences in predominant imagery has prolonged unnecessarily many controversies between psychologists, and others, seems certain. But the valuable and hopeful tendency to study behaviour in detail may lead to further misunderstandings if this elementary consideration is neglected. Mental tests and motion-study, two promising children of psychology, can easily develop the worst features of unmitigated "behaviourism" if they fall into the hands of unreflective workers. This and other risks will be lessened if it be borne in mind that the world of personal experience, expressing itself through behaviour—of which the use of words is only a particular example—is different for different people. At the back of our words, public property as they are, there is a mental region which in different persons is differently deep and broad, differently filled, and lighted with a different brightness.

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The Treatment of Tuberculosis

There are two plagues of the human race, well recognised from the earliest times, which up to the present day have scarcely been influenced in any degree by all the efforts of the physician and the research-worker. Cancer and tuberculosis still remain among the "captains of the men of death"; the one a scourge of maturity, the other perhaps the more terrible, since tuberculosis is the disease of youth and the fullness of life. It seems established that each one of us has at some time suffered from it, and recovered; and that certain strains among our mixed population are more prone to succumb to its ravages than others. Above all, it is certain that consumption, or tuberculosis of the lung, is a disease greatly encouraged by modern town conditions—bad light, bad ventilation, and bad feeding. By careful attention to these points in a sanatorium, we can restore to health a patient who has come from a slum district, a victim to the disease. And then we can only return him to the conditions which caused his original ailment, and which will cause it again.

The cure, then, of consumption must always be a secondary object to its prevention. But that prevention can only be ensured when, in some distant Utopia, all men live healthy lives in healthy conditions, as much of their own choice as from opportunity, Meanwhile, the problem of treatment is ever present and every new method is of urgent interest.

Tuberculin

Professor G. Dreyer has recently published the results of some early applications of a new treatment, which bid fair to open the way to considerable advances. In order to understand the theory of its action, it is necessary to go back to the greatest discovery of recent times in this connection—the isolation of the bacterium of tuberculosis by the German scientist Koch in 1882. It is a very narrow and short thread-like organism, only half the size of a red blood corpuscle, and it is one of a very small group of bacteria which are surrounded by a fatty envelope. The bacillus which causes leprosy is similar in this respect. From the point of view of the bacteriologist who is called upon to identify the orgarism in a patient, its most important characteristic is that, while it can only be "stained" by very strong dyes, it retains its colour even when acids are poured on it.

When the bacterium enters the human body it calls up a response of all the tissue which tends to slay it, and to neutralise the poisonous products which it excretes. Koch tried to increase this curative effort of the body by means of injections of an extract of the bacterium in glycerine. He prepared a series of such injections, known as tuberculins, which differed from each other in some minor respects. In theory they were identical—he wished to induce the body to produce its own medicine in large quantities, by injecting the poisonous substances which caused the disease.

The great hopes which were inspired by the introduction of this new cure, coming from the first authority on the subject, were destined to disappointment. Many cases were made much worse; a violent reaction followed injection, including great swelling at the site of injection and an increase in the fever and general symptoms. In fact, the reaction of the body to the bacterium consisted in strangling it by surrounding its colonies with fibrous tissue, and the effect of injec-

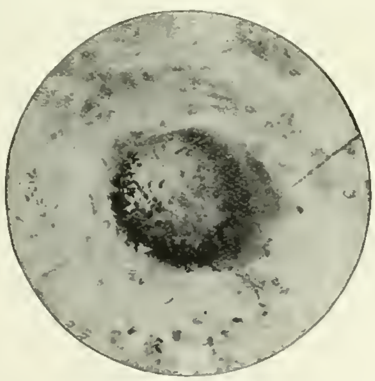
tion was often only to break down this barrier. Eventually the only use to which tuberculin came to be put by most practitioners was as a test of the presence of the disease, since the swelling at the site of injection only occurred in those who were suffering from tuberculosis.

The New Dreyer Treatment

Professor Dreyer's method is, in theory, a similar one. He aims at stimulating the body to manufacture

A CULTURE OF THE BACILLUS OF TUBERCULOSIS.

substances capable of slaying the tubercle bacillus and neutralising its poisonous products. But instead of glycerine extracts or similar preparations, he dissolves off the fatty envelope surrounding the bacterium, leaving it a naked ghost of its former self. It is this fatty envelope which is responsible for the capacity of the bacterium, when "stained," to resist decolorisa-



THE TUBERCLE BACILLUS IN THE TISSUES OF THE BODY.
From "Bacteriology and the Public Health," by Sir George Newman, M.D., F.R.S.E. (John Murray.)

tion by acids, and for long the power of resisting all curative measures which have been tried has been attributed to its protecting cover. An interesting fact relating to this feature of the bacillus is alluded to in *The Lancet* for June 30, 1923. A certain caterpillar which infests beehives has great powers of digesting wax, on which it lives. If preparations of the bacillus are injected into it, they are absorbed in a very short while, without any ill effects to the caterpillar.

Professor Dreyer's is not the only preparation of the bacillus of tuberculosis without its coat which has been produced. In 1918 Dostal and Sahler published an account of their successful efforts to remove it, by growing the bacillus for several generations on a special nutritive substance. Professor Dreyer's method is to dissolve off the fatty coat with chemicals—formalin and acetone.

Tuberculosis is a chronic disease, and temporary improvement, as well as the typical optimism of the patient, have often prejudiced observers in the past in favour of new curative measures. There have been, for example, periods when consumptives were submitted to every variety of pungent oils—garlic, cinnamon, and eucalyptus—with the object of suffocating the bacillus ; more recently considerable claims have been made in favour of the Spahlinger treatment, which is said to be capable of application as a measure of prevention as well as a cure. But the great test of a cure in tuberculosis is whether a guinea-pig, infected with the bacillus, improves under the treatment. No guinea-pig, however garlic-haunted, has ever been cured ; the Spahlinger treatment is still *sub judice* ; Professor Dreyer's injections have definitely improved the condition of such guinea-pigs. A few cases of human beings have been treated also. It is said that the results give great cause for encouragement. Patients with tubercular glands have done particularly well.

The times are peculiarly ripe for a great attack on this fatal disease. Of its own accord—perhaps on account of a widespread improvement in the conditions of life—tuberculosis is decreasing in danger. Fewer cases are reported year by year, and the deaths due to it have greatly diminished in number. But the infection remains with us ; every uncured case is a danger to others. Arrangements are being made to test Professor's Dreyer's remedy on a large scale, and the results will be of the greatest interest.

Although the tubercle bacillus has received the greatest attention in this matter of fat-removal, the prospects opened by the discovery are not confined to it. Other bacteria—notably those which cause abscesses and are known as streptococci—contain fats, which can be dissolved away. Dead bacteria have long been injected, in the form of "vaccines," to produce a general effort of the body and to overcome infection from these organisms. The removal of the fat appears greatly to increase the potency of vaccines, while preventing certain uncomfortable features. In fact, it is possible that we are on the brink of some of the most important advances of the century in the

treatment of diseases due to infection by recognised bacteria.

R. J. V. P.

An article which readers are well advised to refer to in conjunction with the above notes is "Immunity in Infectious Diseases," by Professor A. E. Boycott, DISCOVERY for March 1922, p. 66.

New Light on Old Authors

V. Where was Vergil Born?

By R. S. Conway, Litt.D., F.B.A.

Hulme Professor of Latin in the University of Manchester

"WHY, at Mantua," most school-boys would answer, if they saw the question in this title. And they would be right. But when they reflected that his father was a farmer, that Mantua was a town, and that a farm, especially a large one, cannot very well exist on ground occupied by bricks and mortar, they would see that their answer did not go far enough. They would realise this still more if they had learnt that the whole surface of ancient Italy was divided into what we should call "townships," although the actual towns were often as much as fifty miles or more apart. For instance, a glance at the map (Fig. 1) shows that more than one of the four towns, Brescia, Verona, Cremona, and Mantua, however the area of the quadrilateral of which they made the corners may have been divided, must have reckoned as its own a good deal of land which was many miles removed from its centre.

The point, then, of the question which we are asking is this: in what part of the country round about Mantua did Vergil live? This would not matter very much if the districts on all sides of Mantua were alike. But since, as we shall see, there are great differences in the nature of the country, the actual situation of Andes, which was the name of Vergil's village, probably did matter a good deal to Vergil himself. After all, most people would have a rather different outlook on life if they lived in sight of Snowdon from that which they might have if they lived in the Fens of the Eastern Counties.

The Traditional Site

But perhaps some readers of this article may be prepared to say more than a school-boy would, and may reply that they know, or possibly even that they have visited, a site which is commonly believed in Italy to be that of the ancient Andes, namely a little hamlet called Pietole about two English miles S.E. of Mantua. If they have been there, they will no doubt have seen the handsome monument erected to Vergil's memory some years ago on that spot; and they will understand the feeling of a living citizen of Mantua who, when he read in the Milanese papers last winter some account of the discovery with which this article is concerned, wrote to his local journal in Mantua denouncing the follies of wandering professors who would leave no well-known doctrine undisturbed, and concluding pathetically with the remark that he had been Chairman of the Committee which had erected that monument and so of course he must know! There is this much to be said for him, that the tradition which places Andes in Pietole has prevailed in Italy ever since the time of Dante, who in one passage shows that he believed it; but it has been frequently questioned, and of late years more and more doubted, by scholars outside Italy. It would take too long to examine what little ground there may have been for such a tradition; all that can here be said is that the evidence, though it was enough to give rise to a popular notion that Pietole was the site, was far from being enough to justify it.[1]

Why is the Tradition Wrong?

But perhaps the reader may say, even if he is interested in Vergil's poetry, that after all, wherever Vergil lived, it is rather late in the day for us to trouble about it. Why should we not be content to enjoy his poetry without wanting to inquire more precisely where he was born? The answer is that if we accept the tradition which places his home in Pietole, we have not only to disregard his best biographer—a scholar called Probus, who lived in the first century A.D. and who tells us that Andes was thirty Roman miles, that is twenty-eight English miles, from Mantua—but also to make a considerable part of Vergil's own poetry, and that the part which tells us most about his own experience, quite unintelligible. For we have then to suppose, as we shall soon see, that when he described his own home, he wrote many lines of mere nonsense, to call it by no harsher name.

The Background of the Eclogues

This indeed the commentators admit. One of the best of them tells us that the neighbourhood of Mantua

[1] The evidence consists only of a copy of a fragmentary inscription which, if it ever existed, must have been put up in honour of some member of the Vergilian family. Mommsen thought that the inscription was a forgery. But as the stone, if it existed, has entirely disappeared, it is difficult to say whether he was right; and even if he was wrong, we have no means of telling whether the date at which the inscription was set up was near the time of Vergil.

"does not suit the description of scenery in Vergil's Eclogues." Now taken by itself this criticism is like saying that the description of scenery in Shakespeare's plays does not "suit" the neighbourhood of Stratford-on-Avon. The Eclogues are essentially dramatic; and to criticise their author because the scenery which they mention appears to you different from the scenery of a particular part of a particular country, is just about as helpful as it would be to criticise Macbeth because he did not meet the witches on the banks of the Avon, or Hamlet because his father's ghost did not appear (say) on the battlements of Kenilworth Castle! It is obvious that we must inquire what is the background implied in each separate Eclogue before we can judge whether it is or is not consistent. In the Second Eclogue, for example, the speaker expressly declares that he has "a thousand sheep wandering on Sicilian mountains"; therefore they must be in Sicily; therefore it seems hardly worth while to complain that they are not in Mantua! The scene of the Eighth Eclogue is wholly Greek; the Sixth and the Tenth follow Vergil's friend Gallus over the whole poetical world, taking, so to speak, snapshots of Gallus's poetry, now in Arcadia, now in Thrace, now in Crete, and now in the unknown region where Pyrrha [and Deucalion threw the stones from which, according to the fable, mankind was recreated after all but they had perished in the Deluge. And finally we have the Fourth Eclogue, which sets out to prophesy a new world and ascribes to it all the riches of every known land. It is clear, therefore, that in these five Eclogues the question of local scenery simply does not arise.[1]

But what the critics, no doubt, do mean is this: that in the Eclogues where reference is definitely made to North Italian conditions, for instance in the First, they have been unable to discover any points of scenery which they can identify with what they have seen in the neighbourhood of Mantua. How far they have explored the region of Mantua they do not say.

The Local Eclogues

Of the other five the First and the Ninth tell us, in poetical fashion, how Vergil came to lose his farm. These two we shall have to examine carefully. The local references in the other three (Third, Fifth, and Seventh) are obvious, for example, in the Seventh, the mention of the River Mincius (which flows round Mantua), and in the Third, of the statesman Pollio, governor of Cisalpine Gaul at the time. The Fifth has been shown to be an allegorical lament for the death of Julius Cæsar; and one of the persons in it, by name Menalcas, claims to be the author of the Second and

FIG. 1.—BATHYGRAPHIC MAP OF MANTUAN DISTRICT.

Third. The question, then, which concerns us is whether it is true that the scenery described in these five Eclogues is unlike anything to be found in the region of Mantua. If this is true, Vergil has made a sad mess; and this is what some of his critics seem to take particular pleasure in supposing. Let us see whether they are right.

Why did Vergil lose his Farm?

Save for the mention in the Third of streams closed by sluices, and the frequent mention in all the five of hills, and of nooks in the hills for shelter from the heat, we need not here consider anything but the

[1] The reader will perhaps notice that the numbers of these non-local Eclogues are all even (2, 4, 6, 8, 10). This cannot be an accident; Vergil, in his silent way, has chosen from his early poems five with a local setting and five in other scenes, and arranged them alternately.

two Eclogues concerned with Vergil's farm. In the First we learn that the farmers of the district generally have been turned out to make way for soldiers who have been fighting in the Civil Wars. One named Melibœus has just been evicted and takes a sad leave of Tityrus, who has been permitted to remain in his farm because he went to Rome and secured the favour of a gracious young ruler. There has never been any doubt that by this young ruler Vergil meant Octavian, who seems to have done his best to protect the poet.

enough, and a great part of the land of Mantua was seized also. This is indicated in the Ninth Eclogue, in which we learn that Mantua had suffered because it was "too near a neighbour to unhappy Cremona." And this same passage shows that Vergil himself (for "Menalcas" in this poem means Vergil, as Quintilian tells us) finally had to leave his farm, though it seems clear also that Octavian had not left him in want.[1] One of the speakers says that he had heard that Menalcas had saved his property by his poetry; but the other

FIG. 2.—THE SO-CALLED FONDO VERGILIO AT PIETOLE.

But why were the farmers round Mantua being turned out? Because the troops of Antony, in the year after the battle of Philippi in 42 B.C., in which they had helped to defeat Brutus and Cassius, demanded that Antony and Octavian should fulfil the promises which they had made of liberal pensions. (At this time Vergil was twenty-nine years old.) Now the only form of military pension which the Romans knew was a grant of land, and to these soldiers land had been promised in North Italy. For this purpose the territory of Cremona, a town which had offended Antony, had been entirely confiscated. But even so there was not

replies that the report was untrue, and that in fact both Menalcas and his servant had barely escaped with their lives. Nevertheless the poem goes on to other subjects, and seems to describe Menalcas as being in a fairly cheerful condition and expecting to "sing better songs," that is to write more ambitious poetry.

His Description of the Farm

Now in the course of the story, as it appears in the

[1] Not long afterwards we find him in an estate near Naples, given to him by his friend Mæcenas, the wealthy minister of Octavian.

conversations, we have a good many descriptive points. There are three separate pictures in the First Eclogue. One is of the scene in which the conversation takes place : Tityrus is lying in the shade of a spreading beech-tree, and at the end he points to the smoke rising from farmhouses in the distance as a token that evening is near, since the people in them are preparing supper ; and he also points to the "lengthening shadows" of the "high mountains." We gather also that both of the shepherds live within reach of some small town where they used to take their produce for sale. But the way in which this expedition is described in Eclogue IX seems to show that the town was a good day's journey from the village

The second picture in the First Eclogue is of the farm which Melibœus, a neighbour of Tityrus, has to leave. One of the things which he will no longer be able to do is to lie in a "green cave" or recess and watch his sheep on a bushy slope some way off, on which, while they browsed, they seemed to be "hanging by their feet"—a pretty and exact description of the appearance of sheep on a steep hillside.

The third picture is of the farm of Vergil himself. This is described modestly enough. Melibœus says to Tityrus, who in this Eclogue represents Vergil, that it is quite "big enough" for him, however much it may be "cumbered with bare stones or muddy reeds." And we learn further that it had a willow hedge beloved by the bees, a tall elm haunted by pigeons and turtle-doves, and a cliff under the shade of which the vine-dresser could rest and "sing to the breezes." Other lines tell us of pine-trees and more than one stream ; "familiar rivers and sacred springs." To this the Ninth Eclogue adds, in the lines just noticed, that the estate which Vergil lost ran some distance from the point "where the hills begin to withdraw, and let their ridge sink into the plain by a gentle slope, right down to the water and to the group of beeches, once tall trees, now broken with age." These "ancient beeches" appear also in the Third Eclogue. It must have been a spot which made some impression on Vergil's boyish mind, partly, no doubt, because it marked the end of his father's farm.

From all this it is clear that Vergil meant his readers to think of the farm as being in (or quite close to) hilly country, with steep pastures, caves or nooks in the hillsides, cliffs, rivers, and freshly running springs.

Was it Pietole ?

The defects which critics have felt will be easily understood from a glance at a photograph of Pietole (Fig. 2). The country there is flat ; or, to speak quite strictly, it loses in height above sea-level one metre in a distance of nine English miles, the distance from Mantua to the nearest point of the River Po. Pietole lies just on this line ; and when we consider that Mantua itself lies between two great lagoons, we realise that there is always plenty of water in Pietole, but that it is practically stagnant, since the fall is so slight. The whole country, in fact, is a mere network of dykes and ditches, its only other feature being monotonous rows of willows and tall, lean poplars. Nothing like a hill can be seen ; Pietole is more than thirty miles in any direction from the nearest. And if there were such a thing as a cave or recess to be found, it could only be a kind of rat's-hole in the hollow bank of a large ditch. The photograph of the supposed farm of Vergil at Pietole makes this clear ; and it makes clear also that if Vergil's home was at Pietole, he must have indulged an audacious imagination in describing it as we have seen he does.

FIG. 3.—THE RIDGE RUNNING EAST FROM CARPENEDOLO.

The New Evidence

In 1915 Mr. G. E. K. Braunholtz, in the course of a long study of the inscriptions of North Italy, and especially of the names of places and persons, pointed out that at a place called Calvisano there was an inscription (whose lettering suggests that it was cut in, or soon after, the Augustan period) set up by a member of the Vergilian family; and that at another village, only seven miles off, there was another inscription set up by one Publius Magius, that is, by a member of the family of Vergil's mother, or at all events of a family with the same name. The lettering of this inscription also belongs to precisely the same period (say from 50 B.C. to A.D. 100). He further pointed out that Calvisano, where the first inscription (on an altar dedicated by a lady called Vergilia) was found, was exactly at the distance from Mantua, namely thirty Roman miles, which, as we know from Probus, Vergil's birthplace, Andes, was. Now these coincidences (of names, time, and place) seem too remarkable to be due to accident; and they certainly indicate the neighbourhood of Calvisano, which lies on the road from Mantua to Brescia, as a neighbourhood in which it is at least possible that members of Vergil's family once lived. Of course the Vergilia mentioned in the inscription could not be the poet's daughter, since he was never married; she might have been a sister, though his biographers, in their meagre records, mention no such relative; there is nothing, at all events, to prevent our supposing that she was a niece or cousin who lived near enough to the temple of the *Matronæ* (mother-goddesses) at Calvisano for that to be the most natural place in which she could offer a vow for the health of another lady (probably her daughter) as the inscription tells us she did.[1]

Calvisano and Carpenedolo

The question now before us is clearly this: Does the scenery of Calvisano suit Vergil's description of his own home? In June 1922, and again last February, I did my best to settle this question by visiting the district. Calvisano lies between the rivers Chiese and Mella,[2] five English miles W. of the ridge of Carpenedolo.

FIG. 4.—ROADSIDE STREAM, SOUTH OF CARPENEDOLO.

[1] It runs thus, on the face of an altar, which itself was the object vowed: *Matronabus Vergilia G(ai) f(ilia) Vera, pro Munatia T(iti) f(ilia) Catulla v(otum) s(olvit) l(ibens) m(erito)*. "Vergilia Vera, daughter of Gaius, having received an answer to her prayer for Munatia Catulla, daughter of Titus, gratefully pays her vow." If these two ladies were mother and daughter, the husband of the first and father of the second must have been called Titus Munatius.

[2] This lovely stream is the only one of the small rivers of North Italy mentioned by Vergil in the Georgics (iv. 278), and it is there mentioned, as Mr. Mackail has reminded me, with a special note of familiarity and affection.

This ridge runs beside the River Chiese for some distance from N. to S. and then, turning E., "sinks into the plain by a gentle slope." This is the first visible hill you encounter as you go from Mantua to Brescia. In other words, it is the last outpost of the Alps in the direction of Mantua. Fig. 3 is a photograph of the ridge at Carpenedolo which shows how it melts into even ground. In this ridge there are no caves, strictly speaking; nor can there be in this whole region S. of the Alps and N. of the Po, where the only hills are those made by the great heaps of broken rock and rubble (moraines, as we call them in the Alps) left long ago by the glaciers of the last Ice Age, but now covered with green. But there are a number

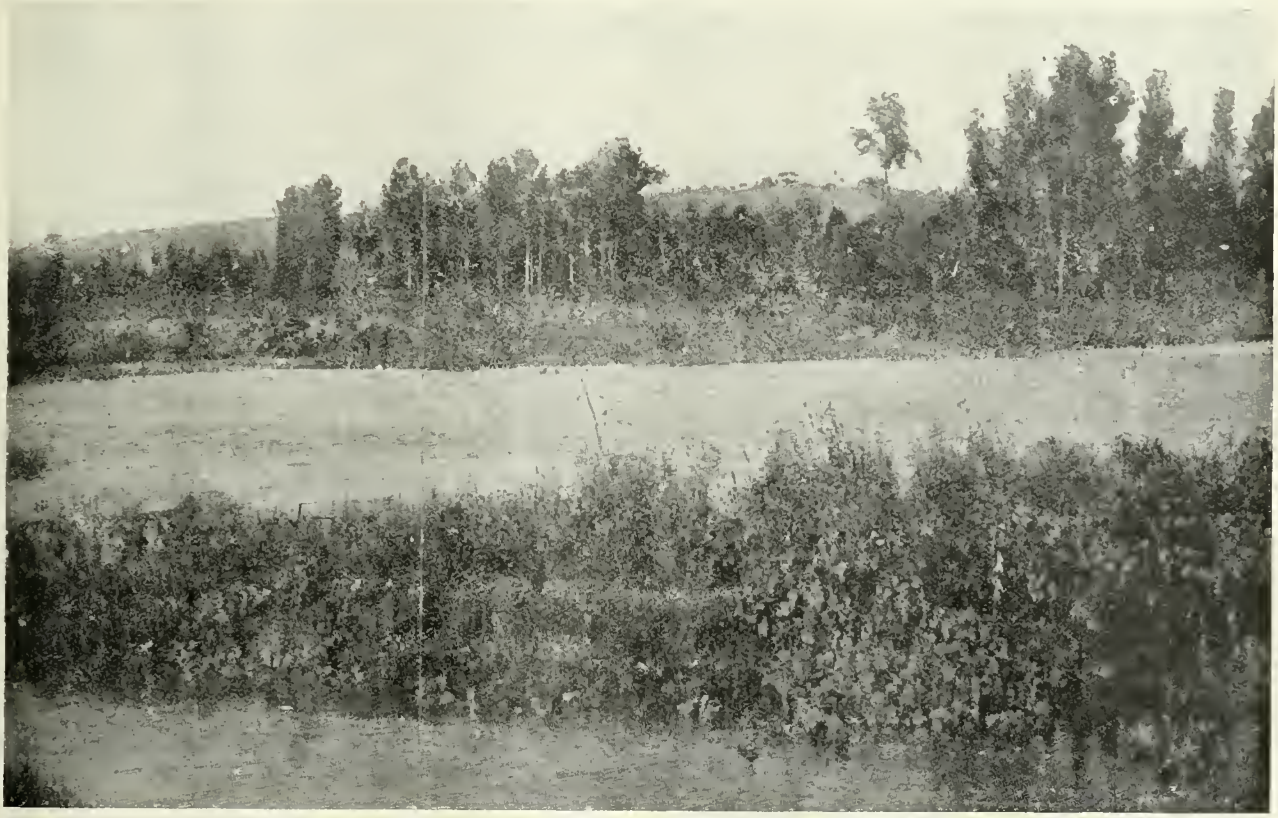


FIG. 5.—THE CHIESE NEAR CARPENEDOLO, WITH THE NORTHWARD ARM OF THE RIDGE BEHIND.

FIG. 6.—THE FOOTHILLS OF THE ALPS SEEN FROM CALVISANO, FIFTEEN MILES AWAY.

of niches and recesses in their steep and often broken slopes which give plenty of shelter from the midday sun, and which afford a view of the steep grassy side of the next hillock. And there are many perpendicular scarps where the side has, at some time or other, been sharply cut away, which, from a little distance, look like cliffs, and which would certainly give plenty of shadow.

Fig. 4 is a photograph of one of the wayside streams just S. of Carpenedolo, which shows how quickly the water runs over the pebbles, utterly unlike the stagnant ditches of Pietole. And the reason for this is obvious, namely that in the 27 English miles between Carpenedolo and Mantua the water has to fall more than 100 metres, that is to say, more than 330 feet, which is a very different thing from 1 metre in 9 miles. Some of these little running streams have sluices in them to hold up the water in a pool whence it can be diverted into the meadows by the side, as the last line of Eclogue III describes.

The last pictures are of the spot on the ridge of Carpenedolo with the River Chiese in front (Fig. 5), where it seems to me likeliest that Vergil's farm stood, and another (Fig. 6) showing the view of the lower Alps, rising sharply (see the map) behind Brescia, which are always visible from Calvisano. On a certain number of specially clear days in the year the great snowy heights of the Adamello group are themselves visible behind; and when they are not visible, they are always covered by a great mass of torn and broken cloud which lends to the distant view just such an element of mystery and wonder as lovers of Vergil know to be the most characteristic thing in all his descriptions of nature.

Full authorities for the statements contained in this paper, in which a good many disputable matters have been treated with brevity, will be found in a paper published in the *Bulletin of the John Rylands Library* (vol. vii, January 1923) under the title, " Where was Vergil's Farm? " I thank my colleague, Mr. W. A. Gould, B.A., cordially for the trouble he has generously taken in preparing the map.

Modern Industries—III

Brick-making in the Midlands

By R. C. Skyring Walters, B.Sc., Assoc.M.Inst.C.E.

THE object of this paper is to describe the brick-making industries of the Midlands, in particular that of the district between Peterborough and Bedford. In this district are situated, perhaps, the largest establishments in the country for making ordinary common building-bricks, known as " Flettons "—the origin of such works being due to the presence here of clay known as the " Oxford clay," which is particularly well suited both as regards quality and quantity for the manufacture of bricks.

The criterion for a clay which will be suitable for making ordinary common bricks is not easily defined, as a *pure* clay (which contains about 40 per cent. of alumina, 50 per cent. of silica, and 10 per cent. of water) is unsuitable for brick-making; and comparatively little is known of the impurities found in natural clays which go to make up a good brick. Chemically, brick-making is not an exact science, for neither the chemical arrangement of the oxides, alumina and silica, nor the effect of the impurities in a clay upon its physical properties, such as its plasticity when moistened, nor its behaviour when calcined, nor its variable colour, is fully understood.

But it is definitely known that brick-making material has been originally formed from the decomposition of rocks, such as granite, which contain felspar (the opaque constituent of granite), the potash or other base of the felspar having been taken away and the alumino-silicic acid,[1] i.e., clay having been left. It is known that the presence of sand in clay tends to prevent the clay from shrinking when burnt, raises the temperature required for burning, and reduces plasticity; whereas the presence of lime in a clay causes shrinkage, a lower fusion-point, and an increase in plasticity. Hence chalk may be added to " lean " siliceous clays; and, on the other hand, sand to " foul " or very plastic limy clays. Ferric oxide induces the red colour; magnesia, the yellow. Iron pyrites tends to split, and certain salts tend to warp or twist or melt, the bricks when they are burnt, and these salts are therefore detrimental.

In short, the known chemistry of clays for brick-making is at present not unlike that of cement some thirty or forty years ago, and there is no doubt that ere long chemists will discover as much about the chemical reactions that occur when a piece of clay is burnt as they know to-day of the reactions between chalk and clay when they are calcined together for making cement. At present the best test for a brick-clay is its trial under the conditions under which it is proposed to be manufactured into bricks on a large scale.

There are, however, certain physical and mechanical properties of a suitable brick-making clay which may be recognised in the field. A suitable clay—

(1) Must be of uniform material, colour, and texture, without patches of chalky or limy material (such as is contained in many drift-clays). Such lime may also be in the form of hard nodules, pebbles, fossil-

[1] Alumino-silicic acid contains about 40 per cent. of alumina, 46 per cent. of silica, and 14 per cent. of water.

FIG. 1.—THE NEW PIT, SHOWING METHOD OF REMOVING TOP GRAVEL OVERLYING 60 FEET OF OXFORD CLAY.

shells, stones, which are all objectionable in varying degrees according to their quantities.

(2) Must not be too plastic or "foul"; such a clay would shrink or crack on burning. The appearance of lime would indicate such a clay.

(3) Must not be too "lean," i.e. it must be plastic enough to hold together during the process of drying; the appearance of grains of sand would indicate such a clay.

The Oxford clay, called "Knotts" in the district under consideration, approximates very nearly to the above ideal conditions. The clay is dug in large open pits some 60 to 80 feet in depth, upon which there lies superimposed a stratum of some 5 to 12 feet of gravel or of clay containing numerous glacial stones and boulders. Fig. 1 shows a common method of removing the top deposit, which is loaded into tip-wagons and deposited into a neighbouring pit from which all the clay has already been dug. The clay itself is won by means of steps (Fig. 2) on which the men work with crowbar, pick and shovel; and the clay is sufficiently hard to stand, winter or summer, without subsiding or falling; and although some of the quarries are upwards of 80 feet deep, the men work on the ledges with perfect safety. Fig. 2 also shows the steep inclined cutting made in the maiden clay to act as a shoot for the material, with the tip-wagon at the bottom ready to receive the spoil. The floor of the quarry is at (or near) the stratum of Kelaways Rock, which forms a comparatively hard and dry working floor. It is not, however, everywhere in the district that such good conditions prevail; locally the top gravel-deposit or "callow" varies remarkably, and the local geology has to be known in detail in order to determine the best sites for sinking new pits; in one quarry it was found that a glacier or a river had scooped out more than half the Oxford clay and redeposited in its stead a silt, containing stones, gravel, etc., which material was quite unsuitable for brick-making. Hence the quarry had to be abandoned at considerable loss.

From the pits of this district have come some of the famous fossilised saurians, collected by Major Leeds, which are now housed at the British Museum, South Kensington. Two or three galleries are devoted to the collection which is known as the "Leeds Collection."

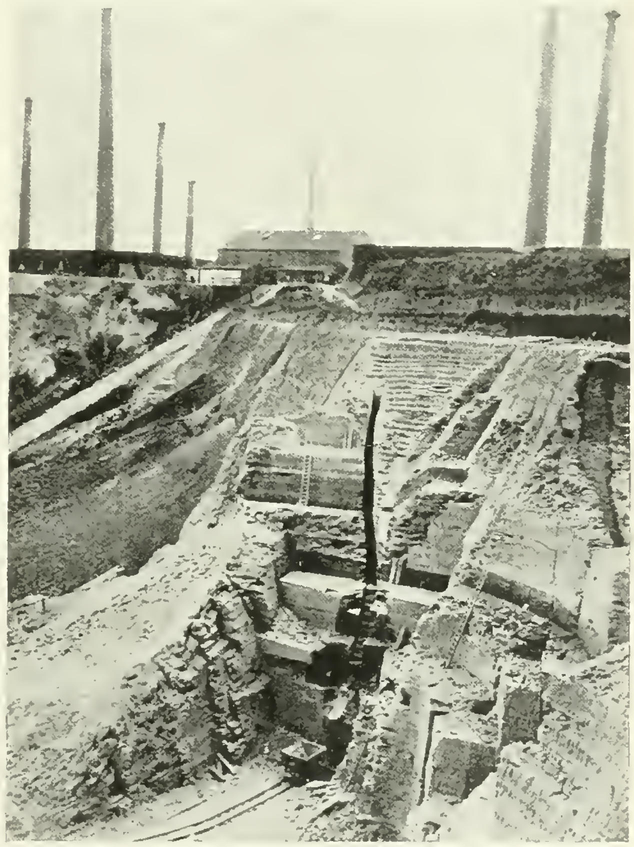


FIG. 2.—SHOWING METHOD OF WINNING THE CLAY WITH STEPS AND SHOOT IN FOREGROUND.
The tramway incline and works in background.

It is unfortunate for the geologist and fossil-collector that the method of quarrying, shown in Figs. 1 and 2, except in the deepest of pits, is fast disappearing

because it is more costly, and that the cheaper method for winning the clay, shown in Fig. 3, is now coming

FIG. 3.—SHOWING ANOTHER METHOD EMPLOYED, I.E. GETTING THE CLAY BY MECHANICAL DIGGERS.

into general use. By this method fossils are broken up and the vertical face cannot be inspected so easily.

The clay is dug by mechanical diggers and is loaded into tip-wagons, which are drawn up a steep incline, such as is shown in Fig. 2, to the grinding-mills, which are somewhat similar to mortar-mills. It is unnecessary to add any material such as lime or sand, and usually it is unnecessary to add water, the clay itself being sufficiently moist, though not too moist; most important of all, the clay may be used as soon as it is dug, and need not be stacked in the open for some weeks or months to mature, as is the case with some clays. After being ground and passed through sieves, the clay is sent to the pressing machines and, with a die, is pressed into bricks measuring $9 \times 4\frac{1}{2} \times 3$ inches. These are removed by barrows and stacked in the large modern Hoffmann continuous kilns (shown in Fig. 2)—very familiar objects in some districts. In these kilns the bricks remain for some three weeks, their size being reduced by burning to $8\frac{3}{4} \times 4\frac{1}{4} \times 2\frac{5}{8}$ inches.

The kiln is divided into some sixteen compartments in one of which the green, undried bricks are stacked. Flues and dampers communicate with each compartment, and from each compartment with the chimney. Feed-holes in the roof of each compartment are also provided By these devices the hot gases are drawn forward from a compartment in which bricks have been burnt, and introduced into a forward compartment for drying the green bricks. When these are dry, further heat can be introduced, and increased by the use of fresh fuel for burning them. For this purpose a high temperature is required. When the bricks have cooled sufficiently, the compartment is emptied and becomes again available. From this it will be gathered that there is always fire in some part of the kiln and that it goes round in one direction; hence the name "continuous" kiln.

The total output from the works round Peterborough is of the order of 8,000,000 to 10,000,000 bricks per week under normal trade conditions.

Animal Fecundity—I

By F. H. A. Marshall, Sc.D., F.R.S.

Reader in Agricultural Physiology in the University of Cambridge

THE variation in fecundity (i.e. in quantity of offspring) in different species was explained by Herbert Spencer in a generalisation which he applied to man as well as to the higher animals. He supposed that the capacity to sustain life and the power to produce new individuals are, roughly speaking, in inverse proportion, an idea which was summarised in the dictum that Individuation and Genesis vary inversely. Amid favourable surroundings and in the presence of abundant easily obtained food the necessary expenditure of energy by the individual is relatively slight; in other words, the cost of Individuation is low, and in such conditions the rate of Genesis is correspondingly increased. Spencer cited the Kaffirs, the Boers, and the French-Canadians as examples of races fertile among men in which the rate of increase was associated with a nutrition much in excess of the expenditure of energy necessary for maintenance, and he contrasts the fertility of these races with that of others amid less favourable conditions.

Less Propagation among Active Animals

Among animals there are countless examples illustrating the same principle. Spencer cited the hare and the rabbit as species closely allied and living on much the same food, but differing in the amounts of energy spent on movement. The relatively inert rabbit may have six young at a time and four litters a year, whereas the more active hare has a smaller number of young in a litter and fewer litters. Moreover, the rabbit begins to breed when six months old, but the hare not until it is a year old. Thus the fecundity of the rabbit as compared with that of

the hare is greater than could be explained if account be taken only of difference in size.

Again, the bat as a rule bears only one offspring at a time, and is thus unusually unprolific for so small an animal; and this is ascribed by Spencer to the relatively high rate of expenditure resulting from the habit of flying. He pointed out, further, that in comparing birds of various species with mammals of the same size and weight, the creatures which are continually going through the exertion of sustaining themselves in the air, and propelling themselves through it, are less prolific than those whose movements are restricted to the surface of the ground. Other instances of the application of the same principle are supplied by the domestic animals which, with few exceptions, have larger and more frequent litters than wild animals belonging to the same species. Thus the tame rabbit will breed six or seven times in the year and may have as many as eleven young in a litter. The domesticated ferret is far more prolific than the pole-cat, which is its wild prototype. The domestic sow breeds regularly twice a year, and sometimes even oftener, and has remarkably large litters, whereas the wild sow breeds less frequently and produces fewer young at a time. The wild sheep has only one young one and a single mating season, while the domestic sheep frequently produces twins or triplets, and, as long ago Aristotle observed, "where the weather is warm and fine and food is abundant may have lambs twice a year."

These and other examples of the same principle are noted by Darwin, who attributes the increased fertility of the domestic animals to a long habituation to a regular and copious food supply without the labour of seeking for it. In a similar way Spencer accounts for such well-known facts as that hens cease to lay when they begin to moult—"While they are expending so much energy in producing new clothing, they have nothing to expend for producing eggs." All these are examples of the more general principle that the energy developed in the body manifests itself in a variety of ways of which the power to procreate is only one. A more special application of the same conception as applied to man, and one that has come into prominence through the teaching of a modern school of psychology, is that sexual energy, instead of being ill-spent or dissipated in unnecessary propagation, may sometimes be more usefully diverted into profitable intellectual channels.

There are, of course, many exceptions to Spencer's law of the inverse relation between Individuation and Genesis (for example, the fact that wild animals, even when tamed and not confined, will often refuse to breed); nevertheless, as a general descriptive statement of the observed facts of nature it represents a true conception, at least so far as the higher animals are concerned. But the ways in which conformity to the law is observed are diverse, and in view of the importance of the subject, not only theoretically but also practically (in relation to man's control over the fecundity of the domestic animals), it is well worthy of study.

High Rates of Propagation

It might at first thought be supposed that an animal's capacity to procreate was controlled mainly by the number of ova or eggs produced by the female, or the number of corresponding reproductive cells (called sperm cells or spermatozoa) given off by the male. In the lower animals this supposition is in a sense correct, for of the total number of eggs produced, say, by a fish, probably the majority are actually spawned, and here the actual fertility is regulated by the number of eggs which become fertilised, and which, escaping the many dangers to which they are subject, are able to complete the process of development. Thus it is stated that the female cod spawns six million eggs, of which considerably less than a third are afterwards fertilised. In the higher animals, however, as well as in many of the lower, only a certain proportion of the potential eggs produced by the ovary or female reproductive gland ever reach maturity at all, and a still smaller percentage are released from the organ so as to obtain a chance of becoming fertilised and developing into new individuals. The late Professor Francis Maitland Balfour, whose early death biologists have not ceased to deplore, showed long ago that in the higher animals one embryonic egg may develop at the expense of others, and that the eggs which disappear may serve as food material for the one ovum which, owing to a superior vigour or to some chance circumstance relating to its position in the ovary, was able to survive.

Cannibalism among Eggs

Thus there is a veritable struggle for existence amongst the reproductive cells during the processes of development within the generative glands, and those cells which survive may do so by taking advantage of the death of others at a very early stage of existence. This fact has been particularly well shown in the freshwater polyp or *Hydra*, and other species belonging to the same class, for in the developing eggs of these animals the nuclei of other ingested eggs continue to be easily recognisable even after the surviving egg has become fertilised and has begun to develop. Similar observations have been made more recently by Dr. Janet Lane-Claypon on the developing ova of the rabbit, and phenomena of the same kind have been noted in other species of mammals. Dr. Arai has estimated that the female reproductive gland of the rat

contains at birth 35,100 ova, but that these are reduced by degeneration to 11,000 after twenty-three days, and to 6,000 by the sixty-third day. That nutrition must play an important part in regulating the proportion of eggs which survive and eventually become mature is a conclusion which is based on observation and not merely on inference. This is a matter which will be considered in a further instalment of this article, dealing with some of the factors which control fecundity in the domestic animals.

Among the Stars—A Monthly Commentary

Discovery of 850 New Nebulæ

In *Harvard College Observatory Bulletin*, No. 784, Dr. Harlow Shapley announces his discovery of 850 new nebulæ on a plate exposed on September 19 of last year, with an exposure of six hours. Dr. Shapley announces that these are "distinct nebulæ," the brighter almost without exception being elongated or spiral, while the fainter are mainly globular in shape. "At the eighteenth magnitude, on many parts of the plate, nebulæ are more numerous than the stars."

A New Theory of the Spiral Nebulæ

Perhaps the most difficult problem in the whole realm of astronomy at the present moment is that of the nature and status of the spiral nebulæ. During the last decade, two main theories have been supported by strong observational evidence. These are (1) the older, or nebular, theory, the exponents of which regard the spirals as true nebulæ, comparatively near at hand as celestial distances go; and (2) the "island-universe" theory, whose supporters maintain that the spirals are galactic systems, situated at immense distances from our own stellar universe. Within the last year or two, the tide of opinion has begun to flow somewhat strongly against the island-universe theory, without giving definite support to its rival. At a recent meeting of the Royal Astronomical Society, Professor F. A. Lindemann outlined a novel hypothesis which is embodied in the society's *Monthly Notices*, April 1923, pp. 354–9. According to this theory the spirals consist of dust-particles, repelled from the stars by radiation pressure. "There must be a continuous stream of fine dust leaving the neighbourhood of the stars and moving towards regions of low radiation density." On this hypothesis, the very high velocities of the spirals are accounted for as a consequence of light-pressure, which may rise to eight times the gravitational attraction in the case of the sun, while "for stars radiating more per unit, it may be considerably greater." Dr. Lindemann further suggests that the light of the spirals is not inherent, but due to reflection from the light of the stellar system as a whole. His explanation of the appearance of novæ in the spirals—that these outbursts are due to encounters between spiral nebulæ and "comet-like clouds of stones or sand"—is, on his own admission, "somewhat artificial." The new hypothesis, which is not out of harmony with certain speculations of Dr. See and a tentative theory outlined by Dr. Shapley, is certainly worthy of serious consideration.

A Stellar Mystery

The daily press reported early in May the discovery of a new star of between the fifth and sixth magnitude in the constellation Cygnus by Dr. Thomas D. Anderson, the Scottish astronomer, at Thurston Mains, Innerwick. Dr. Anderson detected Nova Aurigæ in 1892, and Nova Persei in 1901. A search at the great observatories, however, did not confirm the discovery. Professor Frost reported that visual and photographic observations made at the Yerkes Observatory on May 12 failed to show any nova near to the position assigned by Dr. Anderson, while Dr. Shapley reported that on several Harvard photographs showing stars fainter than the eleventh magnitude no nova could be traced.

AN EXAMPLE OF A SPIRAL NEBULA.
The great spiral nebula, M51, in Canes Venatici.
(*Photo by Dr. Max Wolf.*)

Various solutions of the problem have been put forward. Dr. W. H. Steavenson, at the May meeting of the Royal Astronomical Society, suggested that some confusion had arisen over the two stars 69 and 70 Cygni. "Some of the smaller star atlases show only one star in this region, so that either might well be taken for a nova." In a letter addressed to Sir Frank Dyson, dated May 15, however, Dr. Anderson reiterated his conviction that he had made no mistake, having seen 69 and 70 Cygni, as well as the nova. "That in the early hours of the 9th inst.," Dr. Anderson wrote, "a great stellar outburst was visible near 69 and 70 Cygni, I am as sure as that I am now sitting here at Thurston Mains writing this letter to you." "This Nova Cygni has certainly faded away, I admit, with miraculous rapidity; but if there are novæ which, like Eta Carinæ (Argus), take centuries to go through their evolutions, or like the great nova of 1572 take years, or like the majority of them take months, or like the Nova Coronæ Borealis of 1866 take six weeks, why may there not be stars whose temporary outbursts are ended within a few hours?"

Dr. Anderson's high reputation as an observer certainly militates against the possibility of a mistake on his part, so for the meantime the mystery must remain a mystery.

A New Astrophysical Observatory

It is announced that the Australian Government has resolved to erect an astrophysical observatory near Canberra, the new federal capital. Two telescopes have been secured, and building operations are likely to start at an early date. The erection of another large modern observatory in the southern hemisphere will supply something that has been needed greatly during recent years.

HECTOR MACPHERSON.

Reviews of Books

ANTARCTIC ICE FORMATIONS

British Antarctic (*Terra Nova*) *Expedition* 1910–13. *The Physiography of the McMurdo Sound and Granite Harbour Region.* By GRIFFITH TAYLOR, D.Sc., etc.

Glaciology. By C. S. WRIGHT, M.C., M.A., AND R. E. PRIESTLEY, M.C., B.A. (Harrison & Sons, for the Committee of the Captain Scott Antarctic Fund.)

No part of the Antarctic has been more carefully explored or figured more in scientific memoirs than the McMurdo Sound region of South Victoria Land. We have already elaborate geological papers from the first Scott expedition and from the Shackleton expedition. Even these are eclipsed in voluminous detail by these memoirs of Scott's last expedition. One who has served on a polar expedition knows well the many interruptions that scientific work has to suffer, from weather, travelling, the call to manual work, and so forth. In the face of such difficulties, with which no doubt they had to contend, the amount of scientific research accomplished by Messrs. Griffith Taylor, C. S. Wright, and R. E. Priestley is a monument to their enthusiasm. Dr. Taylor's monograph, written in his customary vigorous style, is devoted to the physiography of the "southern Antarctic" littoral and hinterland, and deals especially with the action of water in the sculpturing of the land. He believes that ice is a less effective agent than ice plus water, and he adheres to the "thaw and freeze" school of glaciologists with leanings at times to the "protective glacier" school. The volume to some extent overlaps the second and larger volume, but that was inevitable and is really an advantage. Messrs. Wright and Priestley have collaborated in the most exhaustive memoir on Antarctic glaciology which has yet appeared, and one that must take its place as a standard work on the subject. Among the fourteen papers in this volume, a few deal with the Antarctic in general and Victoria Land in particular, and some have wider relations.

The classification of land-ice formations has several times been attempted, but not infrequently on too narrow a basis. It is very doubtful if a glaciologist who has no personal experience of Antarctic ice is in a position to tackle this problem, for there is no glacerisation (we use the authors' ugly but useful word) elsewhere to compare with that of Antarctica. The classifications of von Drygalski and O. Nordenskiöld, both of whom have experience of both polar regions, have much in their favour: both are mainly topographical. W. H. Hobbs's classification, on the other hand, though comprehensive, lacks analysis of the major ice formations, and dwells mainly on the minor ice formations of the closing stages of the recession period of a glacial cycle. G. W. Tyrrell lately suggested a new classification based mainly on a study of Spitsbergen glaciers and depending chiefly on the difference in glacier form, motion, wastage, etc., in regions of high relief compared with those of low relief, but this classification is not discussed by Messrs. Wright and Priestley. Their own classification is genetic, and depends on the factors concerned in the degree of glacerisation of a land surface; temperature, precipitation, slope, and denudation or wastage. Thus there are three main types characterised respectively by predominant supply, predominant movement, and predominant wastage. Some forms resulting from a balance between these conditions, and dependent upon their position at sea level, are grouped together as a fourth type. Each type is subdivided partly on the degree of glacerisation, but more especially on the relief of the land. All land-ice formations can be fitted into this classification, and it is certainly admirably suited to a region of advanced but receding glacerisation like Antarctica; but in a region of growing glacerisation—of which, however, the globe does not appear to afford an example at present—it might be less applicable. The outline of the classification is as follows:

I. Ice formations of area of predominant supply.

(*a*) Continental ice masking irregularities of surface (Inland Ice), such as the Antarctic or Greenland ice sheets.

(*b*) Island ice: a similar cap covering a small, isolated land mass.

(*c*) Highland ice which does not completely swamp irregularities of surface: occurs in parts of eastern Spitsbergen.

(*d*) Cwn (or corrie) ice.

(*e*) Snowdrift ice: ice or névé in the lee of projections or in depressions.

II. Ice formations of area of predominant movement, embracing true glaciers moving from the types in I.

(*a*) Wall-sided glaciers unconfined by any marked valley. These are not common and are an exceptional variety of—

(*b*) Valley glaciers, often called alpine or mountain glaciers. These are characteristic of all but the initial and closing stages of the glacial cycle, though "when extreme glacerisation occurs, they will be hidden beneath the upper layers of the Continental Ice and will not thus appear as a recognisable type."

III. Ice formations of area of predominant wastage. These are essentially derived from II, but direct precipitation and snowdrift, and in some cases sea-ice, may augment and compact some varieties.

(*a*) Expanded ice-foot or the lobe of ice beyond the mouth of a valley where a glacier debouches on an unconfined plain. This is more common in such a land as Alaska, where the glacerisation is due rather to excessive precipitation than to snow-line at sea level.

(*b*) Ice tongues afloat: a striking Antarctic ice-form, probably not found elsewhere, unless in Turner Glacier, Alaska.

(*c*) Piedmont glaciers due to the coalescence of several expanded ice-feet. A common type in many polar lands.

(*d*) Confluent ice, formed by coalescence of several ice tongues, and given a definite form by land bar along seaward edge.

(*e*) Avalanche ice fed by avalanches from Type I. All the subdivisions of III have clearly a topographical basis.

IV. Ice formations of zone of balanced forces. These are the most difficult to explain and this is the least satisfactory division in the classification. It includes all forms of shelf ice, of which the most notable example is the famous Ross Ice Barrier.

The authors discuss at length the physics and formation of all these ice forms. As regards the Barrier, they believe that great ice tongues push out into the Ross Sea from the valleys in the surrounding mountain ranges. Sea ice formed in the sheltered waters between them, and, unable to break up or escape, gradually cemented the whole together, while the continual addition of snow smoothed the entire surface. It is now a snow-laden sheet of mixed land and sea ice covering some 150,000 square miles. It is apparently receding, and now probably has a thickness of 750 ft. and an average elevation above sea level of 150 ft. against a possible 800 ft. at the period of maximum glacerisation. Although afloat at its northern end, the whole of it cannot be assumed to be afloat. This and many other equally interesting problems are treated at length in this valuable memoir. Maps and illustrations could not be excelled.

R. N. Rudmose Brown.

A CENTRAL AFRICAN RACE

The Bakitara or Banyoro. By John Roscoe. The first half of the report of the Mackie Ethnological Expedition to Central Africa. (Cambridge University Press, 25*s*.)

No introduction to an author of such well-proven skill and experience in anthropology as the Rev. John Roscoe is required. His knowledge of the races of Central Africa is unique; he has had the advantage of personal and intimate relationship with the native which his great predecessor, Livingstone, possessed; he has that sympathy and understanding of a primitive people which is impossible to many men, but without which an anthropological study must lose half its value and authority.

The nation which is studied in this work occupies a stretch of pastoral country between Lake Albert and Lake Victoria in Central Africa. The name "Banyoro" is really a nick-name, given to them by derisive neighbours from their habit of occasionally showing favour to a member of the agricultural tribes—who are serfs—by making him a free-man, or Munyoro (plural, Banyoro). Hence their country came to be known as Bunyoro, or the land of freed slaves.

The pre-eminent tribes in the land are those whose life centres round the huge herds of cattle. In every ceremony a bull or a cow takes a prominent place. For instance, when a lover selects the lady of his choice for marriage, he must purchase her for anything up to twenty cows. As the marriage day approaches, the bride anoints her skin with butter to make it smooth. After the marriage party, a fat cow is given to the guests to provide an adequate celebration of the occasion. On one occasion, the fourth day after the marriage, the mother-in-law came in, "bringing her son's milk-pot, and handed it to the bride, who had to wash and fumigate it. The mother-in-law supervised the work as if the bride knew nothing about it, and when the milk-pot was cleansed, she brought a churn and explained its use. The girl was then considered to be a fully trained wife and might leave her seclusion."

Similarly, when a death occurred, an elaborate ceremony involving a bull was necessary. "The heir or the head-man of the clan had to send messengers to inform the king of the death, a ceremony which was called 'Kubika.' Two or three members of the clan, chosen for fleetness of foot, started before dawn and drove a bull towards the royal enclosure. When it had reached the entrance they shouted, 'Afulire mukama ayihongire Nyamionga' [He, —— (naming the man), has left the king and gone to the king of the dead]. This cry was an insult to the king, for it declared that the king of the dead had been too powerful for him, and had succeeded

in robbing him of one of his subjects. When they shouted it the men fled, leaving the bull. The guard of the Bamuroga's men, who kept the royal gate, and guarded the sacred drum in the court, gave chase, and if any of the messengers were caught, they were liable to severe punishment, and might even be killed. The guard, however, did not follow far, for they had to catch the bull, kill it, and cook and eat some of the meat before the sun rose. Whatever was uneaten by the time the sun appeared had to be buried quickly in a pit, which had been dug by some of the guard while the others killed the bull and cooked the meat, for the sun might not be allowed to shine upon it. They dared not try to hide any away and eat it later, for not only would their chief punish them, but the ghost would be revenged upon them if they ate any of it in the sunlight."

The Bakitara are a peaceful and intelligent people. They have many industries; iron-smelting is fully developed and the art of pottery is of a high order. In the art of healing, however, they are little advanced. Most of their efforts to alleviate suffering depend on the art of the medicine-man, who devotes his attention to exorcising ghosts. On the other hand, the art of midwifery shows considerable advance, especially with regard to the preservation of aseptic conditions.

Every part of the life of these people is described with great care, and there are a number of striking photographs. It is not possible in the space available to give an adequate impression of the rich mine of interest and entertainment provided, but perhaps one more quotation may be permitted as an example of an ingenious punishment for an unsuccessful rain-maker.

"Should the rain-makers fail to bring rain when it was wanted, the king had a special punishment for them. Their chiefs had to come to court, where the king ordered to be prepared for them a meal of liver, usually from a sheep or a goat, mixed with blood and fat, and cooked with as much salt as possible. The men had to eat this and sit perspiring in the sun until they were tortured by thirst, but no man dared give them water. Sometimes they were kept like this for several days, fed at intervals with salted meat, but allowed no water; and when they begged for a drink, they were told they must get it as rain or die. Their sufferings often caused them to faint, and they have been known to die without any compassion being shown to them."

This certainly was making the punishment fit the crime. And if it rained too hard, they were sent out in the open with huge pots of rain before them, which they had to drink, until the rain stopped. Apparently, to be a medicine-man in Central Africa is no light or easy task!

R. J. V. P.

PSYCHO-ANALYSIS AND GROUP PSYCHOLOGY

Group Psychology and the Analysis of the Ego. By SIGMUND FREUD. Translated by JAMES STRACHEY. (Allen & Unwin, 7*s.* 6*d.*)

In this monograph Freud applies the latest developments of the psycho-analytical theories to the explanation of the phenomena of group psychology. Setting upon one side the transient type of group, such as the lynch mob or the crowd at a football match, he devotes his attention to the more highly organised herd, or, as he prefers to distinguish it, the herd with a leader, which he considers to be the more primitive type. He brings forward the theory that the individual in the group identifies the other members of the group with his own ego in virtue of their common interest, and he is thus able to extend to them the affection and tolerance that he feels towards himself, and even share his property with them.

The bond with the leader is of another kind: the individual substitutes the leader for his own "ego ideal," and by this term Freud means not only the individual's conception of what he fain would be, but also his "conscience," the aspect of himself that criticises and restrains the activities of the more primitive side of his personality. The leader is also something more definite: he is the image of the father or, in the light of racial memory, of the *patriarch*, and here we have Freud's reason for considering the organised herd to be more primitive than the leaderless crowd.

These two emotional ties Freud uses very ingeniously and logically to explain those characteristics of group behaviour (emotionalism, suggestibility, reduction of critical activity, etc.) that have hitherto been attributed to one irreducible factor, such as suggestion or the herd instinct, and brings these characteristics into line with the phenomena of hypnotism on the basis of the theory, already put forward by the psycho-analytical school, that the relationship between the hypnotist and his subject contains an emotional element comparable to that between parent and child.

In dealing with the more highly organised groups, such as the Church and the Army, Freud brings very interestingly into the foreground the social value of repression—a value that is often obscured in psycho-analytical literature owing to its frequent preoccupation with morbid psychology. Freud holds that the energy and altruism displayed by members of the group, and therefore, one might say, the social virtues generally, derive their emotional force from the well-spring of sexual energy that has been diverted into this channel by the repression of it in its primitive form. There is a hint almost of cynicism in the deduction that the social virtues are enduring because the impulse of which they are the sublimation is never completely gratified.

To account for the repression, Freud brings forward an hypothesis that he first published in his book *Totem and Taboo*, in which he imagines the most primitive society as consisting of a large family group ruled over by a jealous patriarch who restrains the sexual instinct of the younger members, and by so doing converts the unused emotion into a spirit of devotion to himself, so long, that is, as they do not revolt against his authority.

By applying to group psychology the results obtained from the study of the unconscious mind of the individual, Freud illuminates the subject with a new light, and, though many of his readers may question his findings,

yet the book should be of the greatest interest not only to psychologists, but to all who are concerned with the problems of sociology.

F. A. Hampton.

British Plant Names and their Derivations. By R. J. Harvey-Gibson. (A. & C. Black, Ltd.)

A little book giving interpretations of the names of common British plants. It should prove very useful to students, and enable them to fix in their memory names which often seem rather unintelligible. Some of them are very quaint—for instance " bonus-henricus, L. *bonus*, good (as distinguished from Mercurialis, called ' bad ') ; *heinrich*, from German *heim*, home, as growing in hedges near villages. Others derive the name from ' Heinz and Heinrich,' evil spirits against whom the plant was supposed to afford protection. In any case, the name has nothing to do with any Henry, King of England, good or otherwise." Much careful research and sound scholarship have gone to the making of this book.

Great and Small Things. By Sir Ray Lankester, K.C.B., F.R.S. (Methuen & Co., Ltd., 7*s.* 6*d.*)

When a distinguished scientist collects his sheaves of scattered papers and articles, written and published in various journals during the last score of years, and presents them in book form, one naturally expects the result to be interesting. And one's expectations are realised in this book, in which, though it contains papers on widely diverse subjects, a sense of unity is preserved since, as the author remarks in his preface, " they all relate to the study of living things ranging from the phagocyte to the gorilla, from the pond-snail to the Russian giant, from facts about longevity to theories as to human progress and the cruelty of Nature." Apart from his writings and individual researches, Sir Ray Lankester has been charged with the responsibility of many important public positions, including the Directorship of the Natural History Department of the British Museum, which he held from 1898 to 1906, and the Presidency of the British Association in 1906. In 1884 he founded the Marine Biological Association. As a man of affairs and as a zoologist his work has been characterised by imagination, enthusiasm, and humanity. These qualities eminently fit him for explaining new scientific discoveries to readers not possessed of the technical languages in which so many of them are veiled as though in the divine clouds of authority.

To many readers, however, the most fascinating articles in this book are those which are more concerned with Sir Ray Lankester's atittude to the general problems and questions of life which are simmering in many heads today, rather than his lucid descriptions of the phenomena of living matter. For instance, he devotes a chapter to answering the question " Is Nature Cruel ? " Man is a sensitive, self-conscious animal. With every century of civilisation his self-consciousness appears to be strengthened and his sensitiveness to mental and physical pain to be increased. This fact is reflected in the modern novel over and over again ; either the novelist introduces pain into his novel and consciously leaves the reader asking, " What is the meaning of it ? " or else he seeks to impose upon his reader the idea of pain, misery, disease, as a mysterious necessity, a part of the scheme of things which must be accepted. Sir Ray Lankester considers that pain does not exist in anything like the extreme pangs which we are apt to attribute to it. " Pain is a mental condition which is not measurable either by the nature and severity of an injury or by the cries and struggles which follow such injury."

The problem of pain has been very carefully studied by the modern schools of psychology, particularly by Freud. These studies show clearly that pain is a protective instrument ; it tells the animal, including man, that it is hurt, or is threatened with disease. The author not only agrees with this dictum, but goes farther and says that " man has been, and is still being, educated by pain." He considers that " pain is not, in the great scheme of the universe, ' cruel,' but the beneficent guide of the development of human beings."

In other chapters the author discusses the problem of old age and longevity, his account of Metchnikoff's theory of prolonging life being admirably lucid. On the subject of telepathy he says : " It is necessary to remind those who continue to assert that ' telepathy ' is a frequent occurrence and ask us to prove that it is not—or else to admit that it is—that their method is universally condemned. It is for them to bring *conclusive evidence* demonstrating the truth of their contention." In another essay the author shows his sympathy for the idea of human progress and the belief that mankind is not merely driving forward blindly into the dark—a belief which certain men of science have recently been too prone to discourage.

The essays on the " small things," on the Phagocytes or Eater-cells, Pond-snails, the Liver-fluke, Wasps, Spider-sense and Cat-sense, and so forth, are splendid examples of the way in which a scientist with imagination can explain technical subjects in an easy, simple, stimulating way for the benefit of a non-scientific reader, as witness this description of protoplasm : " All living things, whether plants or animals, are either single very minute ' corpuscles ' of protoplasm—called ' cells '—or are aggregates, i.e. built-up masses of such cells. Protoplasm is the name given to the very peculiar living, changing ' slime ' or viscid material of which every ' cell ' is constituted. The name ' cell ' was applied two hundred and fifty years ago to the tiny cases, fitted together like the cells of a honeycomb, which the living units, or corpuscles, of protoplasm building up the leaves, stems, flowers, and fruits of plants deposit around themselves. Then the application of the word was actually transferred from the cell or case to its living, slimy content—just as we say ' a bottle of wine,' meaning the liquid contained in the glass bottle and not the glass bottle itself."

E. L.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Sidney Ball. Memories and Impressions of "An Ideal Don." Arranged by OONA HOWARD BALL. (Oxford: Basil Blackwell, 10*s.* 6*d.*)

Statistical Bibliography in Relation to the Growth of Modern Civilisation. By E. WYNDHAM HULME, B.A. (Butler & Tanner, Grafton & Co., 6*s.*)

Ben Jonson's Conversations with William Drummond of Hawthornden. Edited by R. F. PATTERSON, M.A., D.Litt. (Blackie & Son, Ltd., 7*s.* 6*d.*)

Studies in Religion, Folk-lore, and Custom in British North Borneo and the Malay Peninsula. By IVOR H. N. EVANS, M.A. (Cambridge University Press, 20*s.*)

The Growth of the City State: Lectures on Greek and Roman History, First Series. By PROFESSOR W. R. HALLIDAY, B.A., B.Litt. (University Press of Liverpool, Ltd., and Hodder & Stoughton, Ltd., 7*s.* 6*d.*)

The Children of the Sun. A Study in the Early History of Civilisation. By W. J. PERRY, M.A. (Methuen & Co., Ltd., 18*s.*)

The Birth of Psyche. By L. CHARLES-BAUDOUIN. Translated by FRED ROTHWELL. (George Routledge & Sons, Ltd., 5*s.*)

Our Phantastic Emotions. By T. KENRICK SLADE, B.Sc. (Kegan Paul, 6*s.* 6*d.*)

SCIENCE

Special Steels. By THOS. H. BURNHAM, B.Sc. (Sir Isaac Pitman & Sons, Ltd., 5*s.*)

This book is a double number of one of Pitman's Technical Primers, the excellence and cheapness of which have been mentioned more than once in these columns. All steels other than ordinary carbon steel are described with reference to their constitution, their manufacture, and heat or other treatment. The book should prove a useful compilation both for the student and the practical man.

The Elementary Principles of Lighting and Photometry. By J. W. T. WALSH, M.A., M.Sc. (Methuen & Co., Ltd., 10*s.* 6*d.*)

A good account of the whole subject by a member of the staff of the National Physical Laboratory. It is the first connected attempt, we think, to bring the pre-war books on the subject up to date, and gives an informed and interesting account both of present-day theories and current practical work.

Essentials of Modern Physics. By CHARLES E. DULL. (G. G. Harrap & Co., Ltd., 5*s.*)

An easily read, accurate, American book, semi-popular in tone and well illustrated; intended to be read more for general information than to defeat examiners, and including detailed accounts of "wireless" and of the mechanism of the automobile.

Dates and Date Cultivation of the 'Iraq. Part III. The Varieties of Date Palms of the Shatt Al 'Arab. By V. H. W. DOWSON, B.A. (Heffer & Sons, Ltd., 10*s.*)

Practical Wireless Sets for All. Home Construction Made Easy. By P. W. HARRIS. (The Wireless Press, Ltd., 1*s.* 6*d.*)

The Constitution of Matter. By MAX BORN. Translated by E. W. BLAIR and T. S. WHEELER. (Methuen & Co., Ltd., 6*s.*)

Heat and Energy. By D. R. PYE. (Clarendon Press, Oxford, 5*s.*)

Practical Bacteriology for Chemical Students. By DAVID ELLIS. (Longmans, Green & Co., 4*s.* 6*d.*)

Practical Plant Ecology. A Guide for Beginners in Field Study of Plant Communities. By G. A. TANSLEY, M.A., F.R.S. (George Allen & Unwin, Ltd, 7*s.* 6*d.*)

Ductless and Other Glands. By PROFESSOR FRED. E. WYNNE, B.A., M.B., D.P.H., etc. (George Allen & Unwin, Ltd., 4*s.* 6*d.*)

Correspondence

THE BACTERIA OF THE SOIL

To the Editor of DISCOVERY

SIR,

Concerning the above article by Mr. P. H. Gray, of Rothamsted, in your interesting publication of June this year, I wish to know if the following line of thought has been investigated.

I believe it is accepted that nitrification and denitrification are products of the ferments of organic matter, the proportion of one species of organism to its opposite in a given sample of humous soil depending upon aeration or oxygen supply and mineral environment. These two species of bacteria are saprophytes in anabolism and catabolism, but am I right in assuming that the denitrifying organisms become septic parasites during fermentation of purely organic substances—hence tetanus, typhoid, tubercle bacillus, etc.? Can you tell me if any experiments have proved productive of results in tracing the origin of such parasites?

Further, as the most important antiseptics, such as alcohol, with its *Bacillus aceticus*, phenol, as mentioned in your paper, and the others, nicotine, etc., presumably have their ferments, sterilisation is therefore, as Pasteur thought, a matter of thermal consideration only.

Thanking you in anticipation of considering an amateur's enquiry.

Yours, etc.,
C. G. BISHOP.

30 FAIRMILE AVENUE,
STREATHAM, S.W.16.
June 25, 1923.

[The points raised by Mr. Bishop are of some importance, since there is frequently misunderstanding on the question of bacteria in general and those which cause disease. Of the many thousands of species which have been described, only a few dozen familiar forms of bacteria can withstand the rigorous conditions inside the animal organism and

so cause disease. Some of these—for example, the bacillus of tetanus—usually inhabit the soil, as our correspondent states—that is to say, heavily manured soil. It does not, however, "become" malignant at any period—it is always capable of causing tetanus, if it gains access to the human body through a cut. The other bacteria of the soil are, for the most part, as different from the bacteria of disease as a domestic cat from a tiger.

The second question—whether heat alone can be relied upon to sterilise—can be answered by considering the fact that the bacterium is a living creature, or rather a living plant. It is possible to sterilise anything with absolute certainty by immersing it in quite weak solutions of hydrochloric acid. One great feature of all living matter is its sensitivity to acids; when our blood becomes the very tiniest degree more acid, we suffer severe discomfort. Heat, since living matter is capable of being coagulated, like the white of an egg, will kill bacteria; and since surgical instruments, etc., cannot be placed in acids, heat is the method most used for sterilisation.

There are, as Mr. P. H. Gray has shown in DISCOVERY, queer outrageous bacteria which can devour weak solutions of carbolic acid. But concentrated carbolic acid would kill them. The *Bacillus aceticus*, which turns alcohol to vinegar, could not affect what is known as "absolute" alcohol. These bacteria are comparable with those sea-side plants which can grow in the salt spray where daisies and lilies would die; but even they could not stand the salt wastes of the Dead Sea. There is a limit to animal adaptability; some bacteria—the cacti and camels of their kind—can resist most rigorous conditions, but even they can be slain, by heat or by sufficiently drastic chemical treatment.—ED.]

SUSPENDED ANIMATION

To the Editor of DISCOVERY

SIR,

Sir Arthur Shipley, in his contribution to your July number, dismisses "the repeated accounts of toads having been found embedded in rock as fables."

In 1905 I helped to excavate a cellar in Kansas, U.S.A., the summer being well advanced, the weather hot. The two feet of loamy soil were imposed upon a bed of an argillaceous formation several feet thick, in the vernacular designated "hard pan," so dense that a man working hard with pickaxe and shovel could make small headway in a day. Four feet from the surface I struck my pick into a corner and heard a peculiar little pop; on withdrawing the pick I found I had driven it through the body of a toad. The animal kicked convulsively for a few seconds before succumbing. There was the exact print of the toad in the "hard-pan," but no means of exit from its imprisonment that I could discover. The toad was small, and of a pale, sickly cast; there was little pigment in the skin.

Can any person believe that the animal was in that position voluntarily at that season of the year? If so, he can believe anything. The site of the cellar was near an inhabited house; the ground had been well tramped upon for years.

This locality where I now live is underlaid with calcareous, sedimentary rock, the quarrying of which is the principal industry. A short time ago I was informed by an intelligent man, a native, that some years ago a toad was found embedded in the rock, alive, and living witnesses are still here who were present when the animal was discovered.

Yours, etc.,
ALBERT W. HOOTON.

KEINTON-MANDEVILLE,
SOMERSET.
June 27, 1923.

News of the Month

THE SEPTEMBER BRITISH ASSOCIATION'S MEETING

THE annual meeting of the British Association for the Advancement of Science takes place this year at Liverpool, from Wednesday, September 12, to Wednesday, September 19. It will be the Association's ninety-first meeting, and the fifth time that the gathering has been held at the famous port. When the Association went to Liverpool in 1870, it was presided over by Huxley; Tyndall and Rankine delivered the two evening discourses, and Lubbock the "lecture to the operative classes."

With every year the realisation of the need for the practical application of science to life and industry is increasing. The forthcoming meeting is apparently designed to meet this realisation, and its effects may, we hope, be considerable. Its *rendezvous* is appropriate, for, as the Preliminary Programme remarks: "Visiting members of the Association will find a city where the application of science to industry and trade is on every hand."

This year's president is Sir Ernest Rutherford, whose address will deal with the latest researches into *The Electrical Structure of Matter*. The character and trend of the meeting which we have intimated is borne out by many of the sectional addresses. Prof. J. H. Ashworth will consider *Modern Zoology: Its Boundaries and Some of its Bearings on Human Welfare*; Dr. Vaughan Cornish, *The Position and Opportunity of the British Empire*; Dr. C. Crowther, *Science and the Agricultural Crisis*; Sir H. Fowler will discuss *Transport and its Indebtedness to Science*; Prof. T. P. Nunn, *The Education of Demos*; Mr. C. Burt, *The Mental Differences between Individuals*; and Sir W. H. Beveridge will show the relations of *Unemployment and Population*.

Some of the sectional discussions, too, should be of much practical value—those, for instance, on *Psychological Assumptions Underlying Economic Theory*, *The Methods of Anthropology in Relation to the Social Sciences*, *The Outlook for British Agriculture*, and *The Delinquent Child*.

Two interesting features of the meeting are that public lectures are to be delivered by various members of the Association to the public and to children in Liverpool and various neighbouring towns, and that Sir William Rutherford's address will be broadcasted by wireless.

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Binding cases for Vol. III, 1922, are now ready. Price 2*s.* 6*d.* net each; postage, 9*d.*

Editorial Notes

THE ninety-first annual meeting of the British Association for the Advancement of Science takes place this month at Liverpool during the week September 12th to 19th. In our last issue we published a short account of the addresses and discussions which will mark this year's meeting. A full account of the meeting will appear in our October number. There are obvious signs that these gatherings of distinguished scientists are beginning to gain a strong grip on the popular imagination. An increasing characteristic of the meetings is the effort on the part of those who deliver addresses to make their subjects intelligible to their audiences. Even to-day, however, despite these efforts, the highly intelligent audiences, composed largely of scientists and workers in other fields of knowledge, find difficulties in following the papers that are read from end to end—a commentary which may appear rather venturesome, but which is an admitted fact.

* * * * *

Science has become a very "specialised" concern; physics and chemistry subjects have never been easy to explain to the uninitiated; much of the language in which they are conducted to-day will not be found in any ordinary dictionaries; physiology is full of alien words; even the newer sciences of psychology and anthropology have coined their own nomenclature. All this is as it should be, so far as research is concerned. Scientific language is, in fact, a necessary medium for specialists to convey the fruits of research to other workers in the same sphere in a concise and accurate manner. But when this language, or even the slightest smattering of it, is introduced by a scientist into a supposedly popular article or paper—well, to be Irish, the article becomes thoroughly unpopular.

* * * * *

Is there any way of getting over this difficulty? As we have said, the British Association has made gallant attempts to do so. Certain scientists have through a life of research retained sufficient imaginative sympathy to write of their work in their plain native tongue; even a few journalists, through a life trained to regard all events as "copy," have retained sufficient perspective and desire for accuracy to describe new scientific discoveries without undue exaggeration or inaccuracy. Both types, however, are rare, though they may well be encouraged, for they perform a work of exceptional value. A possible solution to the problem lies in the co-operation of scientists and trained writers (who can still preserve the attitude of the average man) in giving the public eminently readable books and articles on scientific subjects. At any rate, the British Association is doing admirable work in its endeavours to bring the latest results of experiment and study before that somewhat nebulous individual, "the man in the street."

* * * * *

The announcement of a new airship service to India, which the Government has decided to support, comes soon after the arrangements for a trans-Atlantic airship line between Spain and South America. Details of this Spanish scheme are given by Major W. T. Blake, the well-known airman, in this number of DISCOVERY. We are far from believing that the days of airships are over and that they have yielded place to the aeroplane in their own particular capacity for long-distance cruising. Much research has been successfully carried out during the last eighteen months with regard to the safety factors governing this form of air flight. These new services will provide safe, comfortable, and speedy travel over long distances, and they have a great future in front of them.

* * * * *

An outbreak of small-pox—the most severe for

many years—occurring in the year in which the names of Jenner and Pasteur are celebrated, is a serious commentary on the generation which, inheriting their great discoveries, has neglected to take advantage of them. A very large percentage of the population of England to-day is un-vaccinated; a very small percentage has taken the essential precaution of re-vaccination. We do not know the terrors of small-pox because our fathers took the trouble to become vaccinated; our children will doubtless rediscover them through our omission to do so. The danger involved in this simple process is probably much less than is incurred by anyone who suffers a scratch with a pin—for in that case there is always the chance of infection; while with the simple precaution of cleanliness vaccination causes at most a day or two of inconvenience.

* * * * *

It would be interesting to attempt an analysis of the mental processes of those who belong to that surprisingly large body of people who disbelieve in practically every advance in medical knowledge for the last hundred years. They are not, of course, a production of this age alone. The history of all learning is marked far more by tales of the oppression and even martyrdom of the discoverer of new things than by the gratitude of those who are emancipated or enlightened. We can always hear—

> "The cry of these ye humour
> Ah, slowly, to the light,
> 'Why brought ye us from darkness,
> Our loved Egyptian night?'"

The fact that there is a party in politics calling themselves Conservatives—we speak with no political bias whatever—and that they have a subdivision known as "Die-hards," who, in the words of *Punch*, yearly die in a fresh ditch, indicates that opposition to any new thing is a fixed habit of the mind of men. The simplest virtue is changelessness. "A stopped clock is right twice in twenty-four hours," but this spirit of stolid immobility, which has certainly its uses in preventing too precipitate a course of action in politics and social matters, is not the only factor in the opposition to the theories of modern medicine. There is a distortion of reasoning evident in the perpetual demand for "proof" of the efficacy of this or that process. "Proof" is a relative thing. Apart from certain mathematical statements, few facts are susceptible of "proof" in the most rigid sense of the word. Where a human factor is involved, the difficulties of proof are infinite. There are people who, like the Scotch visitor to the Zoo, can look at an elephant and say, "I don't believe it." Only a few centuries ago, "proof" in scientific matters really meant that Aristotle had made a definite statement on the point. Strangely enough, few were then sufficiently brave to say, "I don't believe Aristotle." But to-day, when each man has better opportunities of investigating the grounds for belief in a statement made by a scientist, a large number of people are ready to disbelieve it without any investigation at all.

* * * * *

In the case of the treatment and the prevention of disease, "proof" is a hundredfold more difficult than in the case, for example, of a statement that a gas expands in a regular manner when heated. The doctor deals with living creatures. There is only one statement which can be made with absolute certainty about a living creature, and that is that it will die. We are not sure whether a certain sect of Christian Scientists admit even that much. The argument in favour of vaccination, of typhoid inoculation, of the germ theory of disease, rests on the record of a vast series of observations favourable to them. On the other hand, there are many facts in each case, many examples of apparent failure, which point in an opposite direction. Thus, any discussion of the efficacy of a curative or preventive method quickly becomes a battle of statistics. No one ever reads statistics. Still less does anyone verify them; they are merely the ammunition of the combat, for the vaccinationist and the anti-vaccinationist, the bacteriologist and the anti-bacteriologist. In many cases, one group of figures refers to a condition of affairs completely different from those dealt with by opposition figures. For example, anti-vaccinationists perpetually bring forward the case of the Philippine Islands, where, after many years of the apparent prevention of small-pox, it again broke out with redoubled vigour. The facts are that, during the period in which it was successfully prevented, vaccination was done by United States officials; when it broke out, vaccination was being neglected under the auspices of the local authorities.

* * * * *

Of course, the belief which a doctor or a layman holds in the value of a well-tried method of cure or prevention rests in "statistics," or facts which might be expressed as an imposing mathematical table. But that belief rests also on a wide experience, a knowledge of the thousand-and-one factors which have intruded in each separate case. There are very few doctors among the disbelievers in the theories of modern medicine. It is often said that this is because it pays them to believe in them, and to practise their teaching. Every doctor, however, knows that there is far more money to be made by following any one of a hundred will-o'-the-wisps of quackery than in the narrow path of the learning bequeathed by Jenner, Pasteur, and Lister. Life is as much a puzzle to the doctor as the weather

is to the farmer. Only a few gleams, it is true, yet appear to guide him on his way. Against him he has arrayed all the forces of anti-vaccination, anti-vivisection, anti-inoculation and anti-antisepsis. Much that he believes to-day will undoubtedly prove wrong to-morrow. At least we hope so, for it would be sad if our resources of to-day were all that we shall ever command in the conquest of pain. But what man, who sincerely studies the basis of modern belief, can doubt that the great promise of to-morrow is foretold and derived from the hard-won triumphs of the much-maligned practice and theory of to-day?

* * * * *

The recent announcement of the discoveries of bones of prehistoric monsters, at least five million years old, but beautifully preserved, in the Gobi Desert, Mongolia, must have caused surprise even to those who have carefully followed up the investigations in this region. In fact, the discovering expedition's report says that "the first month of the expedition's work is far beyond our hopes. Where we expected only fragments we have discovered an immense deposit of large and small dinosaur bones."

For many years past the possibility of enormous "finds" of early mammalian remains in Central and Southern Asia has interested zoologists and other scientists, and in this connection the discovery some years ago in Baluchistan, by Mr. C. Foster Cooper, Superintendent of the Museum of Zoology at Cambridge University, of the bones of that giant prehistoric animal, the Baluchitherium, evoked great interest. Since then the American Museum of Natural History, New York, has dispatched several successive expeditions to investigate the more central Asiatic region of the Gobi Desert. It may be recalled that the expedition of 1922 discovered vast fossil fields, rich cretaceous, tertiary deposits, the skull of a baluchitherium, the complete skeletons of some small dinosaurs, and the remains of two thousand mammals.

* * * * *

This year's expedition, under the leadership of Mr. Roy Chapman Andrews, has been even more successful. As the report of the discoveries has only just reached New York via Pekin, it is impossible as yet to give full details, but the "finds" include herbivorous dinosaurs 30 feet long of the Iguadon type, and smaller carnivorous species, the skull of a giant rhinoceros, "almost as perfect as though the animal had died a week ago," the remains of a huge dog-like carnivore, and the teeth and jaws of an "ancestral tapir-like animal." It is obvious that the expedition has made the richest "find" of prehistoric animal life ever recorded, and that this "find" almost conclusively proves that the mammalian life, which subsequently spread to Europe and America, originated in Central Asia.

A Transatlantic Airship Service

By Major W. T. Blake

Plans for the airship service between Europe and South America have now been completed and the preliminary work is already in hand. The scheme originated in Spain, the King being largely responsible for its inception, and the company to operate the airships is Spanish, with Spanish capital.

When the scheme was mooted, the company called in the Zeppelin firm and obtained from them the exclusive right to the use of Zeppelin airships for communications between the Latin-American countries and between these and the rest of the world, among the conditions being a proviso that the ships should be constructed in Spain under the supervision of German engineers.

The technical report of the Zeppelin Company gives plans for the building of airships of a larger size than any so far constructed, though these ships are only a step towards much larger vessels when the service has proved its reliability and paying capacity. The design is for an airship of medium speed and a moderate lift.

The principal dimensions are as follows:

Capacity	135,000 cub. metres (4,500,000 cub. ft.)
Overall length	250 metres (825 ft.)
Maximum cross-section	33·8 metres (110 ft.)
Overall height	37 metres (122 ft.)
Maximum width, including airscrews	36 metres (119 ft.)
Lift	141,500 kg. (139 tons)
Useful load	75,000 kg. (73·8 tons)
Commercial load	15,000 kg. (14·75 tons)
Engines	Nine, 400 h.p. each
Maximum speed	132 k.p.h. (82·5 m.p.h.)
Cruising speed	110 k.p.h. (68·5 m.p.h.)
Range	12,000 km. (7,500 miles)
Accommodation	40 passengers, mails, and goods

Liners of the Air

The body of the ship consists of a rigid light-metal framework, fabric-covered, containing seventeen gas-bags. This framework is of the normal Zeppelin type, consisting of longitudinal girders and a system of main transverse frames with bracing, secondary frames without bracing, and diagonal bracing of the rectangular intervals between the girders. The main transverse frames divide the ship into compartments, in which the gas-bags are contained.

The usual stabilising and control surfaces are fitted. There are four pairs of engine cars identical in design, which are suspended on either side amidships, the ninth motor being situated centrally aft. The pas-

senger car is well forward of the engines, so that noise and wind need not inconvenience the traveller.

The air-screws are of wood with aluminium beading at the tips and along the leading edges. They are provided with reversing gear, and in addition with disconnecting and fixing gear.

The control car is built in with the hull and contains all over the ship. Cabins for the crew and officers are provided in the walking-way near the control car and in the stern.

The passenger accommodation is exceedingly good. The cabins and saloon are continuations of the control car, the space for passengers being 33 metres (108 ft.) long, and 5 metres (16 ft.) wide. Five cabins are

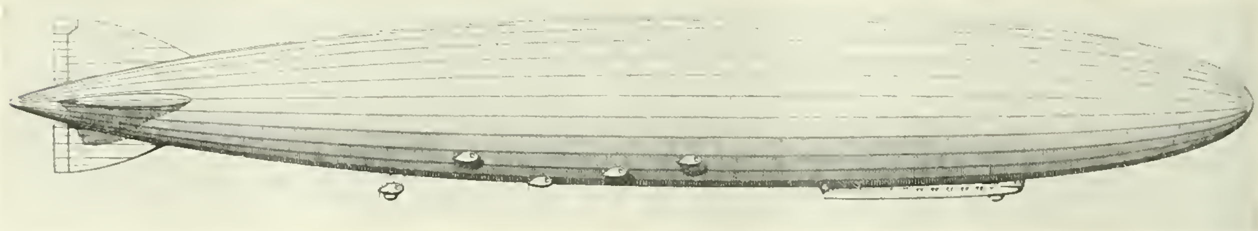

FIG. 1.—A GENERAL VIEW OF THE TYPE OF AIRSHIP TO BE EMPLOYED.

the principal controls, gas and ballast distributing boards, telephones, and navigating and other instruments, all essential installations being duplicated. The rudder-controls are in the front part of the car, and the elevator-controls on the port side. In addition there is an emergency-control station in the walking-way near the aft engine car.

Orders are transmitted to the engine cars and crew's provided, each for eight people, and at night each cabin can be converted into two sleeping-rooms, with four berths in each. Beyond these is a dining saloon, kitchens, bar, lavatories, etc. Space for baggage, goods, and mails is provided in the walking-way. Passengers will have all the comforts of an Atlantic liner without the disadvantage of sea-sickness.

It must not be thought that these airships constitute

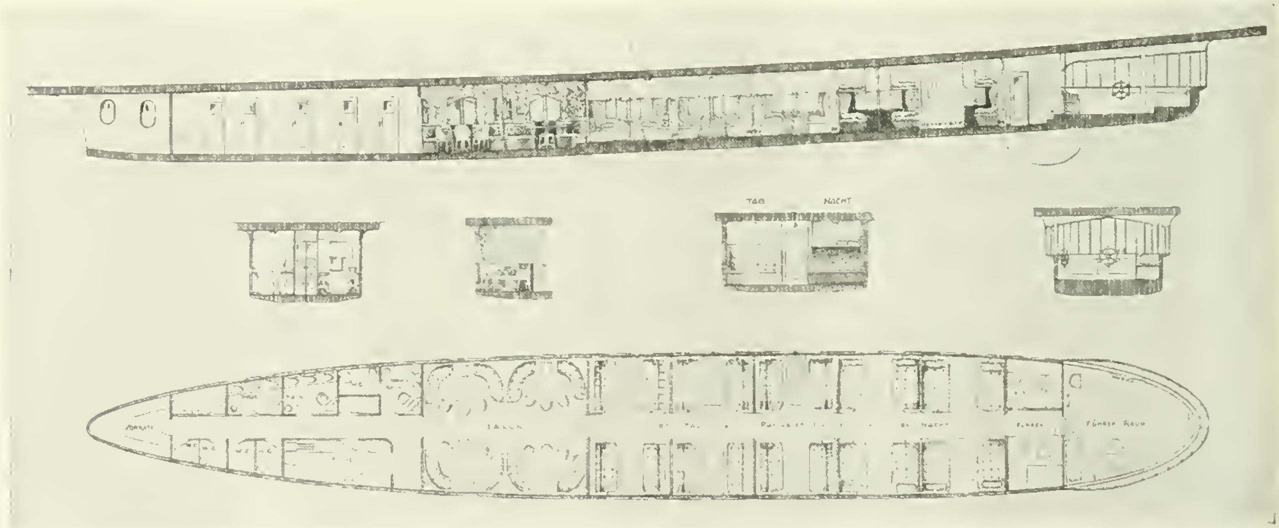

FIG. 2.—SECTIONAL DIAGRAMS OF THE AIRSHIP.

cabin by means of the engine telegraph, placed on the starboard side of the control car.

Aft of this car is a sound-proof wireless cabin and the commander's cabin. The range of the wireless is 2,000 km. (1,250 miles). Power is obtained from a dynamo driven by the wind created by the movement of the ship, which dynamo also provides electric light the final type, as they are simply a link between existing types and the transatlantic airships of the future, which will be of about 180,000 cub. metres in capacity (6,000,000 cub. ft.), and will have a speed of 144 k.p.h. (90 m.p.h.) and accommodation for sixty passengers.

In order to give a basis of comparison with previous ships I give some figures for the L71, the biggest

German airship at the end of the war, and the British R36, the biggest proved English airship:

	L71	R36
Length	743 ft.	672 ft.
Cubic capacity	2,420,000 cub. ft.	2,101,000 cub. ft.
Engines	Six, 260 h.p.	Two, 260 h.p. Three, 350 h.p.
Gross lift	78 tons	64 tons
Range	6,000 miles	4,000 miles
Speed	75 m.p.h.	65 m.p.h.

Safety Precautions

Every possible precaution is being taken for the safety and reliability of the service. The most experienced pilots of the Zeppelin firm, each having at least a thousand flights to his credit, will be engaged, and these men will accompany the Spanish personnel until they are absolutely proficient. Every ship will carry six pilots and a commander. Engine breakdown is guarded against by having only five engines running at one time, the others being held in reserve.

A smaller type of ship will be built for school purposes, and a possible service between Spain and the Canary Islands. These airships will have the following dimensions:

Capacity	30,000 cub. metres (1,000,000 cub. ft.)
Length	144 metres (472 ft.)
Diameter	21·1 metres (69 ft.)
Total lift	31,500 kg. (31 tons)
Useful load	13,000 kg. (12·8 tons)
Engines	Three, 400 h.p.
Maximum speed	125 k.p.h. (78 m.p.h.)
Cruising speed	110 k.p.h. (68 m.p.h.)
Range	3,000 miles
Accommodation	16 passengers

Air Ports

The service is scheduled to take place between Seville in Spain and Buenos Ayres in the Argentine. At both these places huge stations will be erected, whilst intermediate landing-grounds will be provided in the Canary Islands and at Cordoba in the Argentine.

At Seville three big airship sheds will be erected, one 300 × 90 × 50 metres, the second 300 × 50 × 50 metres for the airship works, and a third 150 × 50 × 50 metres for the school airships. All these sheds will be of a fixed type owing to the regularity of the wind directions in that part of the world. In Buenos Ayres, owing to the variability of the winds, either a revolving shed 280 × 50 × 50 metres will be needed in addition to a fixed hangar, or a circular shed with sixteen doors will be built. In the Canary Islands and at Cordoba mooring masts only will be erected.

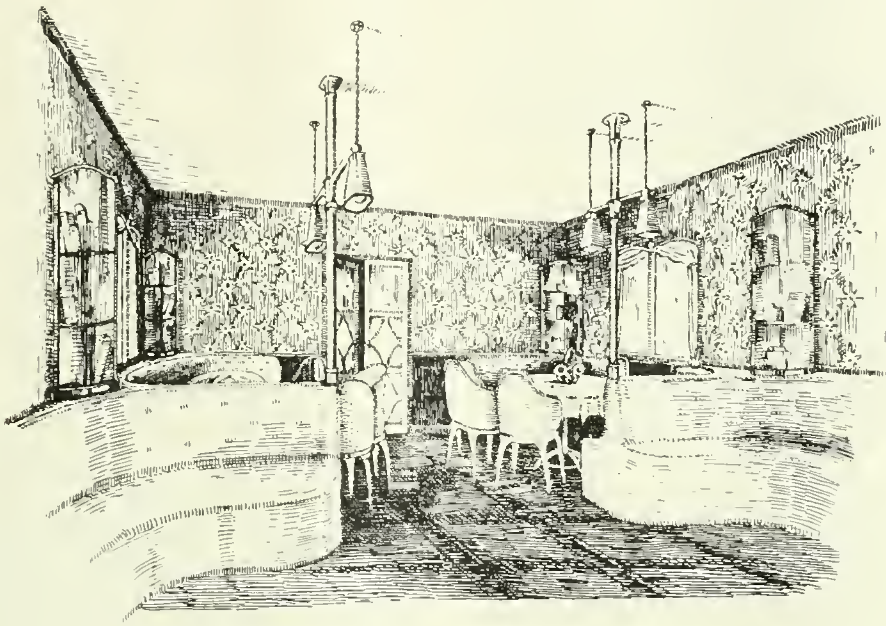

Fig. 3.—A corner of the saloon.

The whole work of construction should take about two years, so that the service will probably be inaugurated in 1925. Services will then be made twice weekly in each direction, the journey to the Argentine taking 3 days 16 hours, and the journey to Spain 4 days 6 hours, the longer time being due to the prevailing head winds.

A fare of 6,000 pesetas (£240 at normal rate of exchange) per passenger will be charged, whilst letters will be carried at a rate of 2.25 pesetas (1*s.* 10*d.*) per package.

The French Government and the British aviation service authorities are showing great interest in the scheme, and both French and British firms have submitted offers for the manufacture of hydrogen, con-

struction of sheds, and the insurance of personnel, airships, and installations. British firms have also offered to assist in building the airship under the supervision of and in accordance with the plans of the Zeppelin engineers, using British workshops and sheds. An American firm is also negotiating for the organisation of an airship service between Buenos Ayres and Chicago.

The Secret of the Photographic Plate

By T. Thorne Baker

One of the most fascinating problems of modern physical chemistry is undoubtedly that of the action of light on the photographic plate. We know that an image cast by a lens upon a sensitive plate for a twenty-thousandth part of a second can produce an invisible change in the film, known as the "latent image," which at once, or years afterwards, can be converted into a negative image by the action of a suitable reducing agent.

We know, too, that there are very slow plates, used in the making of process negatives for half-tone reproduction, on the one hand, and other plates of the most extraordinary rapidity on the other, which are all made with one common sensitive substance, silver bromide.

What is the difference between the slow plate and the plate fifty times as sensitive? What is the cause of sensitiveness, and what limits the ultimate sensitiveness to be attained? These are questions to which, obviously, the research chemist of the plate factory devotes most of his attention, but during the past five years the British Photographic Research Association has concentrated a great deal of valuable work on the subject, and quite recently some really definite information has been got together and made available.

Photographing Negatives with the Microscope

If a photographic negative be examined under the microscope, the image will be seen to consist of innumerable fine "grains" of reduced silver; but if a small fragment of the undeveloped film be dissolved in water, and examined with a high power, it will be found to consist of considerably smaller grains, or actually crystals, of silver bromide. The secret of the photographic plate lies in these crystals, their formation, growth, and physico-chemical treatment. A great deal of excellent work has been done during the last two or three years in the refinement of the technique of photographing them with the microscope. By using a Pointolite lamp as light source, and preparing films one layer thick only in silver bromide crystals, images of the latter, having a magnification of as much as 3,000 diameters, can be projected with $\frac{1}{12}$-in. oil-immersion objective upon a drawing-board several feet away. The apparatus must be mounted on a vibration-free table, and with a little practice perfectly satisfactory photographs of the crystals can be obtained. The crystals are first of all focused upon a piece of white paper, and after a red light filter has been placed in the optic axis at some convenient spot, a plate is pinned to the drawing-board in the desired position, and the exposure made by removing and replacing the light filter.

When the silver bromide is first obtained—as a precipitate formed by mixing ammonium bromide solution with silver nitrate solution in the presence of gelatin—the crystals are so small that all attempts so far to resolve them have failed, and they therefore appear as spherical particles. In this preliminary form the silver bromide is in an extremely insensitive state, so much so that it may safely be exposed to weak artificial light without danger of "fogging." Hereafter follows the ripening, during which the particles gradually evince their crystalline shape and incidentally gain in sensitiveness many thousands of times.

Fast and Slow Plates

The crystals are not all of the same size, but may vary very considerably. It would appear that the larger crystals can actually absorb smaller ones and grow at their expense, though this is by no means proved. The character of the plate, however, depends largely upon the general character of the crystals. Thus if their size be fairly regular, the resulting plate will be vigorous in character, and give great contrast such as is required by the process or photo-mechanical plate. The uniformity in size will produce this type of plate even though the crystals may be of the large type usually associated with fast plates. Certain it is that in the ripening or digesting process the crystals grow to a far larger size, and that it may be said in general that the crystals in a fast plate are always larger than those in a slow one.

The plate which gives good gradation has been found to obtain a very mixed selection of crystals, the diameters probably varying as much as twenty times. Large crystals have been grown on recognised lines which have exhibited very beautiful patterns, and might possibly possess enormous sensitiveness, but their size would preclude them from being used in a commercial plate. The published work of many

experimenters shows that the increase in size and sensitiveness of the commercial crystals can be obtained by two methods, one being the heating of the emulsion to a considerable temperature, the other the digestion of the emulsion at far lower temperatures in the presence of ammonia, which is a solvent, in a slight degree, of the silver halide. But what actually happens to the crystals in the ripening process is still a mystery. One can obtain, for instance, large crystals of comparatively low sensitiveness, and small crystals of very great sensitiveness compared with the usual run of small crystals.

Slowing-up Fast Plates

Examination of the sensitive crystals by Svedberg, Toy, Sheppard and Trivelli, and others has shown that on the surface of the crystals, and frequently at the edges, are "sensitive spots" of possibly adsorbed matter, and it is assumed that these local centres are in some way responsible for the increase in sensitiveness. Clark has recently found that by treating "fast" crystals with chromic acid, and thereby removing the sensitive spots, they become greatly reduced in speed, and that crystals of different degrees of sensitiveness all appear to become reduced to one common level of speed when so treated. This would tend to indicate that ripened silver bromide, *per se*, is of a very low sensitiveness (about 6 H. and D., or probably much less), and that the speed of the plate is obtained by depositing on the crystals as many as possible of these reduction centres. What they are is

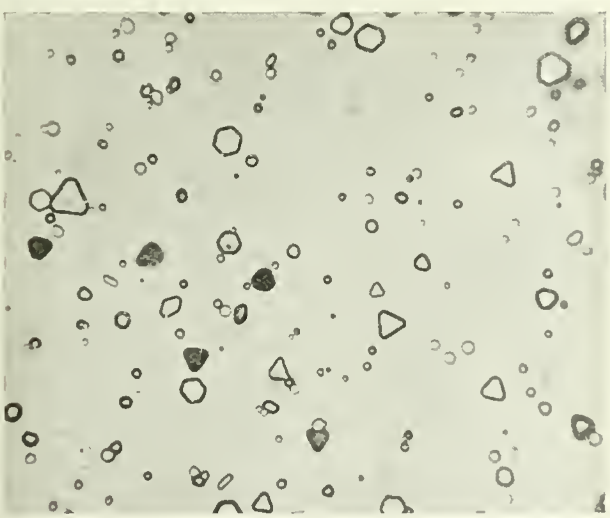

FIG. 1.—CRYSTALS OF AN EMULSION AFTER RIPENING TO A SPEED OF 50 H. AND D.

at present very uncertain. They must, of course, be derived from impurities in the water, the gelatin, or from the other raw materials used. The adsorbed matter is extremely small, and may itself be supremely sensitive and easily ionised by light, or it may behave purely as a catalyst, aiding the chemical change without undergoing change itself. If the substance

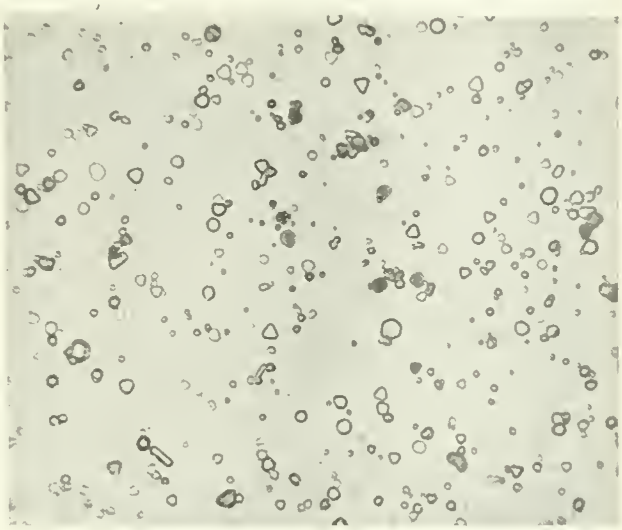

FIG. 2.—CRYSTALS OF THE SAME EMULSION AFTER RIPENING TO A SPEED OF 200 H. AND D.

be an actual silver compound, its presence within the crystal lattice may be discovered by X-ray analysis.

Effect of Light on the Sensitive Silver Bromide Crystals

A point much in dispute at the moment is the manner in which the sensitive crystals of silver bromide are affected by light. Is the crystal more sensitive the greater number of sensitive nuclei its surface presents, or can the physico-chemical character of the crystal itself make it more readily affected by the nuclei, independently of their number (or size)? Controversy exists around the theories of the character of light itself—whether it is a mere wave motion or partakes of the character of innumerable darts as propounded by Silberstein. If the light-dart theory held good—and there seems at present sufficient ground for doubting it—one would think that the area of the crystal alone would decide its sensitiveness; but this is not the case, as has been already stated.

Whatever be the actual procedure in exposure, and whatever be the character of the latent image, we have gained this knowledge as the result of recent research—that the grain or crystal size and character control the character of the emulsion, that one can to a great extent predict the ultimate character of a plate by previous micrographic analysis of the emulsion, and that the sensitiveness of the silver bromide is due to what for convenience we may call impurities deposited on or adsorbed by the crystals.* That this knowledge will lead to important progress in the art of emulsion-making, and to the production of vastly more sensitive

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plates for astronomical, X-ray, and other scientific work, is certain. Meantime, active research is being continued by quite a considerable number of the world's leading chemists and physicists.

How the German Revolution was Effected

By R. B. Mowat, M.A.

Fellow of Corpus Christi College, Oxford

Since the early years of the nineteenth century, ever since the national revival that followed upon the disaster of Jena and the occupation of Berlin by the French in 1807, there has been a large class of liberally minded people in Germany. These were mainly middle-class, educated people—patriotic, public-spirited citizens, who read about the affairs of their country and of the world, and discussed them with broad-minded intelligence. Stein and Humboldt, Niebuhr and Fichte were such men, during the period of the Napoleonic wars; such, too, were the members of the famous official family of von Gagern in the following period; such were the historians like von Sybel and Mommsen.

The Parliament of Frankfort, 1848

In 1848 this school of thinkers and others, men of action, made their fine attempt to establish a "Liberal Empire," an attempt which resulted in the famous but short-lived parliament of Frankfort. After the year 1864 the Liberals—or National Liberals as they came to be called—were pushed out of public affairs by the firm-mindedness of Bismarck. They continued to supply able officials to the civil service, and after 1871 (the end of the Franco-Prussian War) they were powerful in the new Reichstag, which, however, under the Constitution, had little more than the functions of a debating society. Although useful to the country as bureaucrats and "publicists," the National Liberals exercised no controlling influence on the policy of the Empire.

Rise of the Social Democrats

In the last twenty years of the Empire's existence the ineffectiveness of the National Liberals, who at one time seemed to have a fine future before them, left the field of official opposition open to the Social Democrats. The Social Democratic Party was active and highly organised. As the National Liberals were a democratic party based on Individualism, the Social Democrats were a democratic party based on Socialism. They were not all of the same colour; there was a right, a middle, and a left—that is to say, there were Social Democrats who were comparatively conservative (the Right); these were others who were moderately socialistic; and there were some (a fairly large section) who were frankly communist (the Left). As long as the Social Democrats were in opposition to the Imperial Government they all seemed to be tending towards the Left. They were, it seemed, the only alternative to the Cross Party—the Junkers, or official Conservatives—who filled the high places in the Imperial Government since Bismarck's time.

The Political Events of November 1918

The choice for Germany lay between the Junkers and the Social Democrats; the National Liberals were "out of the running." Therefore, when the Junker Government collapsed owing to its military failures of July–October 1918, the direction of public affairs in Germany was left inevitably to the Social Democrats. The fateful question for Germany was, "Which section would take the control, the Right, Middle, or Left?" That is to say, the choice now lay between the official Social Democratic Party (which was comparatively moderate), the Independent Social Democratic Party, and the Communists, or Spartacists. Practically the choice lay between the moderate Socialists and out-and-out Communists. Russia, faced with a somewhat similar set of alternatives in the previous year, had been taken over by the extreme Communists.

The accepted date for the German Revolution is November 5, 1918, when a naval mutiny took place at Kiel. But the army, as a whole, remained outside the revolutionary movement. The Kiel mutiny, however, acted as a signal for civilian outbreaks in Bavaria, and, on November 9, in Brandenburg. The revolution had been foreseen and prepared for during the previous five or six weeks; and when it occurred the movement was at once taken in control by the Majority (that is, the moderate), Socialists, the official Social Democratic Party.

In the early days of November, with the prospect of an armistice on practically surrender terms, the Kaiser's Government had been rocking to its foundations. On Friday morning, November 8, the executive officers of the Social Democratic Party (of whom the chief were Ebert and Scheidemann, two moderate Socialists, at this time ministers in the Imperial Government) issued an ultimatum to the Chancellor, Max of Baden, demanding the abdication of the Kaiser by midday. It was hoped by this means to avoid actual revolution. The Kaiser did in effect abdicate by fleeing to Holland on the morning of Saturday the 9th (although he did not sign his act of abdication until

November 28). On the same morning as that on which the Kaiser fled from Army Headquarters to Holland a great strike of working men occurred in Berlin and elsewhere. This was the actual moment of revolution, and this was the point at which the Majority Socialists took the movement in hand.

At 1 p.m. (Saturday, November 9) a proclamation, in the name of "The Workers' and Soldiers' Council," was issued as a fly-sheet by the newspaper *Vorwärts*, the chief Socialist organ. The *Vorwärts* had made a steady stand against Bolshevik Socialism. The proclamation announced that a large part of the Berlin garrison had placed itself at the disposal of the Workers' and Soldiers' Council; it pleaded for the maintenance of quiet and order; and ended with, "Long live the Socialist Republic!"

This proclamation was followed within two or three hours by another, which showed the hand of the well-organised Social Democratic Party:

"Fritz Ebert, the chairman of the Social Democratic Party, has become Imperial Chancellor, and is forming in the Empire and in Prussia a new Government of men who have the confidence of the working population in town and country, of the workers and of the soldiers. Herewith public power has passed into the hands of the people. A National Assembly to settle the Constitution will meet as quickly as possible."

The Provisional Government, November 9

This proclamation showed that a self-appointed Provisional Government now existed. Prince Max of Baden left the seat of government and went to Baden; and by 8.30 p.m. the new Government was complete. It was a Cabinet of six, who had the ominous name of People's Commissaries; this name, however, was apparently almost from the first given up in favour of that of *Imperial Government*. The six were Ebert, Scheidemann, and Landsberg, Majority Socialists (i.e. members of the Social Democratic Party), and Haase, Dittmann, and Barth, Minority Socialists (Independent Social Democratic Party). The head of the Cabinet was Ebert, Chancellor, who now signed the proclamations. These proclamations, issued before the fateful evening of Saturday, November 9, came to an end, stated the programme of these relatively conservative revolutionaries. The first proclamation said:

"The Social Democratic Party has taken over the Government and has offered entry into the Government to the Independent Social Democratic Party."

It went on to state that the Constituent National Assembly would be elected by the suffrage of all citizens, both sexes, over twenty years of age. Finally it declared that human life was sacred, and that "property is to be protected against illegal interference."

This statement that property (which plainly meant private property) was to be respected, disclosed the essential mark of the Revolution, as the Social Democratic Party would have it. It was a direct challenge to the Communists, under whatever name they were known, such as Bolshevists or Spartacists. The leaders of the Social Democratic Party went further; they published (also on the night of November 9) the demands addressed to them by the Independent Socialists and their answers. In those answers the leaders took their stand wisely on the will of the people. To the demand "that Germany is to become a Socialist Republic," the answer was "it is for the People and the Constituent Assembly to decide." Another demand was: "The whole executive, legislative, and judicial power is to be exclusively in the hands of the chosen men of the total labouring population and the soldiers." The answer to this was: "If this demand means the dictatorship of a part, a class, without the majority behind it, we must reject this demand, because it would run counter to our democratic principles." A third demand was: "Exclusion from the Government of all bourgeois members." This was refused for the very practical (though not very logical) reason, that "it would seriously endanger the feeding of the people, if not make it impossible."

Germany becomes a Moderate Socialist Republic, November 12

On November 12 the definite programme of the Provisional Government was issued. It declared that the Revolution had produced a Government "whose convictions are purely Socialist." This Government, accordingly, was making certain arrangements "which will have the force of law." These arrangements were, chiefly (1) the abolition of martial law; (2) the suppression of the law of compulsory civilian service; (3) the enactment of an eight-hour day, and the increase of industrial insurance compensation; (4) a housing and unemployment scheme; and (5) the maintenance by Government of "ordered production," and protection of property "against private interference"; (6) the freedom and security of individuals. The spontaneous co-operation of the bulk of the people, the absence of any general resistance, showed that this programme had the approval of the community as a whole.

Thus, by November 12, the day after the Armistice, Germany, as the result of a Revolution, had become a Socialist Republic, based upon the principle of depending upon the whole people, of drawing its officials and representatives from every class indiscriminately, and of respecting the safety, freedom, and property of all individuals.

That the Revolution might have taken a very different course is proved by the powerful and bitter Spar-

tacist risings which took place in January and March 1919. That a stable Government and social system, based upon the normally accepted principles of European civilisation, were produced was due, chiefly, to four things. Firstly, the general will of the German people obviously was in favour of such a Government and social system. Secondly, the army leaders, headed by the potent personality of Hindenburg, who was a kind of living legendary hero, accepted the Revolution, and the soldiers followed their leaders. Thirdly, the civil service, a large, efficient machine, consisting, except in the highest posts, of educated bourgeois people, went on functioning, while the Provisional Government made no attempt to displace or "purge" it. Finally, that the Revolution was more like a peaceful transition, a normal development, was largely due to the group of resolute, moderate men who made themselves into a Provisional Government and from the first moment controlled the movement. The natural bulwarks of society should have been the National Liberals, educated, experienced, liberally minded middle-class men, such as saved France from the *Communards* after the fall of the Second French Empire in 1870. But the National Liberals, the natural leaders of the democracy, had lost their birthright when they accepted the brilliant autocracy of Bismarck's military empire. Failing the National Liberals, German society was saved by the Social Democratic Party, and chiefly by Ebert, the former saddler, who took over the Chancellorship from the hands of Prince Max of Baden on that fateful ninth of November.

[Note.—The chief documents concerning the German Revolution were translated and published in America by *The Living Age* on March 1, 1919. They were reprinted by the American Association for International Conciliation in April 1919. It is from these documents that the quotations made in the above article were taken.]

[Readers are also referred to an admirably lucid description of "The German Federal Economic Council," and the ideas and events that led up to it, to be found in *Representative Government and a Parliament of Industry*, by Herman Finer (Fabian Society—George Allen & Unwin, Ltd, 1923, 7s. 6d.).—Ed.]

An Alphabet of Gods

By Lewis Spence

Author of "The Gods of Mexico," "The Civilisation of Ancient Mexico," etc.

It is a somewhat depressing commentary on our knowledge of the wonderful civilisation of the Maya Indians of Yucatan and Guatemala that, although we are aware of the names of many of their principal gods, we are still unable to identify the sculptured or painted representations of them carved on the walls of ruined temples, or depicted in the three exquisite manuscripts which are all that remain to us of Maya literature. This is largely due to the difficulties which have been encountered in deciphering the hieroglyphs which undoubtedly contain the names of these divinities. The personalities of the Maya pantheon are, of course, sufficiently familiar to us, their insignia and general significance hold few remaining secrets. But the names and titles of the Maya gods as handed down by tradition and the writings of the early Spanish missionaries we cannot apply to the carvings or pictures of divine beings with any degree of confidence, and until such time as the native system of writing is finally revealed to us, we have adopted the expedient of labelling the portraits of the gods with the letters of the alphabet from A to P.

The first student of Maya antiquities to apply this provisional and truly scientific system of nomenclature was Dr. Paul Schellhas, who so long ago as 1897 introduced it to the notice of Americanists as "a purely inductive natural science method," essentially amounting to "that which in ordinary life we call 'memory of persons.'" By an intensive examination of the pictures of gods in the manuscripts he learnt gradually to recognise them promptly by the characteristic impression they made as a whole. He was assisted in this not only by dissimilarities in face and figure, but by such details as the constant occurrence in the case of each god of some outstanding hieroglyph, ornament, or other symbol. He dealt with the figures in the manuscripts alone, and avoided all hypotheses and deductions. The present writer, following in his path, has, however, not refrained from application to those other sources of information which he ignored, and by degrees has been enabled to arrive at a rather fuller comprehension of that extensive Maya godhead to whose worship the gorgeous temples of tropical America were erected.

Schellhas candidly admitted his lack of knowledge of the places of origin of the three invaluable manuscripts which preserve for us those graceful and delicate representations of a forgotten Olympus. But Dr. H. J. Spinden, of the American Museum of Natural History, in his monumental book on *Maya Art*, has, by a careful comparison of the art-forms of those wonderful aboriginal paintings, dissipated nearly all existing doubts on the question. The Codex Dresden he assigns to the region south of Uxmal in Yucatan. In the Codex Peresianus he finds marked similarities to the art of the ruined cities of Naranho, Quirigua, and Piedras Negras in Peten, a district immediately to the south of the Yucatan peninsula. As for the Codex Tro-Cortesianus, he believes it to have been the work of a painter living in the northern district of Yucatan. It is, of course, manifest that all of these must be copies of much older manuscripts, and Spinden is of

opinion that the last-mentioned may be dated not much later than A.D. 1200. This means that all three originated in those districts which had been colonised by the Maya after they had left their original settlements in Guatemala and had been driven northward into Yucatan by racial pressure, and it is clear that all have reference to the same deities and arose out of one and the same religious impulse.

The God of Death

The god first encountered in this alphabetic sequence, God A, as he is generally described, is without doubt that grisly genius who in all mythologies presides over the realm of the departed. He is readily to be recognised by his skull-like countenance and bony spine and the large black spots, denoting corruption, which cover the emaciated body. He wears as a collar the ruff of the vulture, the bird of death, and a symbol which usually accompanies him, but which Schellhas was unable to decipher, undoubtedly represents the maggot, evidently a kind of hieroglyph for death. But the distinguishing glyph for this god is a human head with eyes closed in death, before which stands the stone knife of sacrifice. In one part of the Codex Dresden God A is shown with the head of an owl, the bird of ill omen, his almost constant attendant, and this recalls to us a passage in the *Popol Vuh*, a religious book of the Maya, which states that the rulers of Xibalba, the Underworld, "were owls," the inhabitants of a dark and cavernous place.

I believe God A to be Ah-puch, the death-spirit mentioned by Father Fernandez. His name means "the Undoer" or "Spoiler," and he was also known as Chamay Bac or Zac, that is "white teeth and bones." In some of his portraits he is decorated with a feather, on which are seen the markings of the flint knife, and I have deduced from this that the glyph for "feather" was synonymous with that "knife," a notion which I have substantiated from the fact that in Maya the first wing-feather was called "a knife."

The personality of God B is a much debated one. He has a long proboscis and tusk-like fangs, and certain writers on American antiquities have called him "the elephant-headed god." Apart from these peculiarities his eye has a characteristic rim, and he is easily recognised by the strange headdress he wears, which I take to be a bundle of "medicine" or magical appliances. And here it may be as well to say that I believe the headdresses of these gods represent the earliest symbols by which they were known to their priests and worshippers in the period before writing was invented, or hieroglyphs came into use. They would thus rank as hieroglyphs, as something to be immediately recognised or "read," and probably acted as a definite step to the invention of written symbols.

That God B has an affinity with water is plainly evident. He is seen walking on its surface, standing in rain, fishing, paddling a canoe, and even enthroned on the clouds. He is connected with the serpent, which is, in America, the water-animal *par excellence.* In some places, indeed, his head surmounts a serpentine body, and, like the priests of the modern Zuñi Indians of Arizona, he is represented as clutching tame serpents

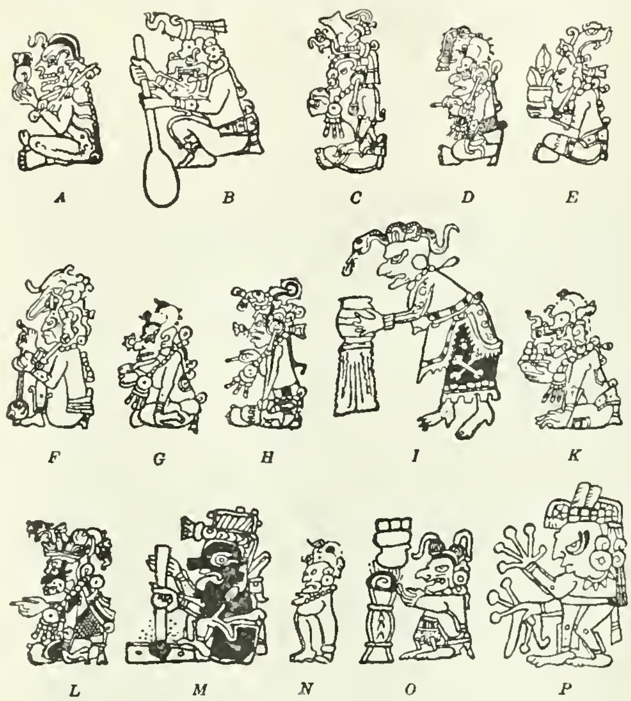

FIG. I.—THE ALPHABET OF GODS.
(Taken from Maya MSS.)

in his hands. Like the old British god Kai—the "Sir Kay the Seneschal" of Malory—he bears flaming torches. Kai was a god of the waters; so, in some measure, is God B.

The "elephantine" aspect of this god is accounted for by his wearing the mask of the medicine-man or priest, worn during the religious ceremony. Indeed in one statue of his analogous Mexican form we see him in the very act of removing this mask. In Mexico the mask resembles the beak of a bird; in Central America it is more like a snout—whether that of an elephant or other animal I do not possess sufficient data to give an opinion.

God B is, indeed, none other than Kukulkan, "The Feathered Serpent," the Maya name for the Mexican Quetzalcoatl, the god of the rain-bearing trade-wind. But in Central America proper, whence he originally hailed, he is more intimately connected with water than with wind, and the learned priests of his cult explained him to the Spanish conquerors as "the

ripple wind makes on water," the ruffled feathers on the serpentine stream. But in later times he came to be regarded as the priest who conjured down the rain by magic, and his possession of the *calñac*, or rain-maker's wand, places his position in this respect beyond all question.

Sky Deities

Coming to the third letter of our alphabet of gods, we find God C simple of explanation. At first sight his outward semblance may seem puzzling. His face is framed by the painted border seen on the *xamach*, or flat dish on which the Maya baked their tortillas or maize pancakes. But *xamach* also means " north," so that in this instance we have an example of that

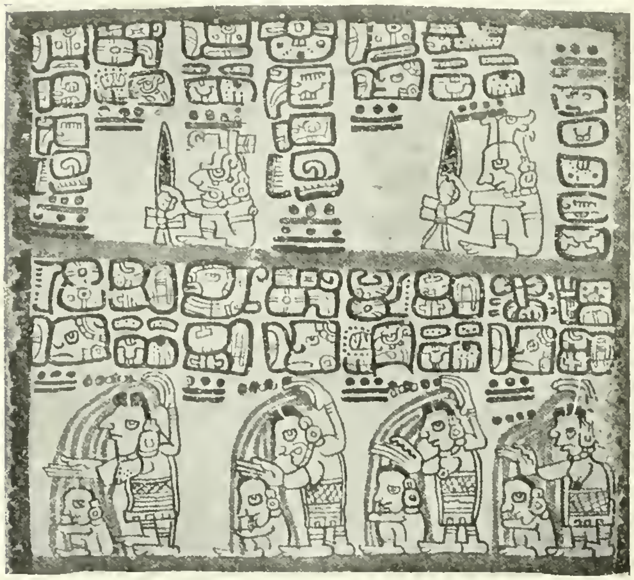

FIG. 2.—REPRODUCTION OF PART OF A MAYA MS.
Above, Gods B and E are seen ; below, a variant of Goddess I. The lesser figures in lines show the Maya hieroglyphic system of writing.

rebus-writing on which the Maya hieroglyphical system was undoubtedly based. There was, we know from tradition, a god called Xamanek, who represented the pole star, and that God C is identical with this deity scarcely admits of any doubt. In the Codex Cortesianus we see his head surrounded by a nimbus of rays which can symbolise only stellar emanations, and in the same manuscript we find him hanging from the sky in the noose of a rope. Elsewhere he is accompanied by familiar planetary signs.

In D we have a god of night and the moon. He is represented as an aged man with toothless jaws, and is indicated by the hieroglyph *akbal*, " night." His head, in the reduced cursive writing of the texts, stands for the sign of the moon, and this is frequently accompanied by the snail, the emblem of birth, over which function the moon had planetary jurisdiction. Among the Maya deities D is the only one who can boast of a beard, a certain sign in the case of the neighbouring Mexican pantheon that a god possesses a planetary significance, and for this reason, no less than because of his venerable appearance, I would collate him with Toñaca tecŭtli, the Mexican creative deity, father of the gods, the Saturn of their Olympus. This figure was known to the Maya of Guatemala as Xpiyacoc, but can scarcely be collated with Hunab Ku, " The Great Hand," the " god behind the gods," invisible, impalpable, of whom we are assured that he was represented in neither painting nor sculpture.

In God E we have such a definite picture of a divinity connected with the maize-plant that we have no difficulty in identifying him as Ghanan, the traditional Maya god of the maize, whose other name was Yum Kaax, " Lord of the Harvest Fields." He bears the maize-plant on his head, and this, becoming in course of time the conventionalised form of an ear of maize with leaves, composed his hieroglyph. His face-paint, too, frequently bears the symbol of fertility, and the rain-vase is depicted as an ornament above his ear.

God F, in his insignia, is reminiscent of the Mexican harvest-god Xipe, whose annual festival brought forth such grisly horrors of human sacrifice. He has the same distinguishing vertical face-mask, implying " war," for plenteous harvests were only to be secured by drenching the soil with the blood of many prisoners taken in battle. He is, indeed, a war-god, and is occasionally represented in full war-paint, with flint knife and blazing torch, setting fire to tents or huts. In some places he is pictured underneath a stone axe in the shape of a hand, with thumb turned upwards, which probably has an inauspicious significance.

God G is not often represented in the manuscripts. He appears to be a sun-god, and his hieroglyph, a circle enclosing four teeth, is believed by some authorities to symbolise the " biting " nature of tropical heat. His own teeth are filed to a sharp point. His head-dress recalls that of the priesthood of Yucatan, and in some of his representations has a certain resemblance to the Egyptian wig. There is, indeed, no question that it is a wig. He frequently holds the flower symbolic of a life rendered to him in sacrifice, and is occasionally depicted standing amid tongues of solar flame, a central eye blazing upon his forehead. That he is Kinich Ahaŭ, the sun-god, is scarcely open to dispute. Another of his hieroglyphs consists of a composite picture, including a solar disk, the sign *been*, which means " straw-thatch," and the sign *ik*, which in this connection is to be translated " fire which strikes upon the roof," in allusion to the frequency with which the thatched roofs of the Maya were ignited by the fierce rays of the sun of Yucatan.

A Storm-goddess

The distinguishing characteristic of God H consists in what is known as the *chiccañ* or serpent-spot appearing on his brow. He has practically no other distinctive marks, and that he has some relation to the serpent is clear. With I we come to the first of the two goddesses represented in the list—a divinity of water. She is scarcely prepossessing, and has claws in place of feet. She wears on her head a knotted serpent, and seems to pour the flooding rains from a large vessel. But she is evidently not a beneficent deity, for her face is distorted by an expression of angry menace, and it is obvious that she personifies water in its more harmful guise—the baneful flood rather than the gentle rain. In some of the representations of her water belches from her mouth, breasts, and armpits, and she wields the rattle of the thunder-storm.

Such data as we possess regarding the deity indicated by the letter K is not of a kind that would permit us to arrive at any very definite conclusions regarding him. He closely resembles B, and has even been confounded with him by some authorities. He is frequently represented on the walls of the temples of Copan and Palenque, so it follows that he must have been a divinity who ranked high in the galaxy of gods. He has the same description of mask, with elongated snout, as B, but his hieroglyph differs very markedly from the symbol of that god, representing as it does an almost ape-like head with a peculiar foliation in the region of the forehead—a constant feature of his pictures. From his position as lord of the calendar years which belong to the east, Professor Seler believes him to be Ah-Bolon tzacab, "Lord of the Nine Generations." In my view he is a variant of B. The two most famous deities among the Maya, Kukulkan and Itzamná, were undoubtedly one and the same in origin and essence, although in later times they came to be regarded as rivals and as swaying the fortune of opposing cities, and I believe K represents Itzamná as B is unquestionably Kukulkan.

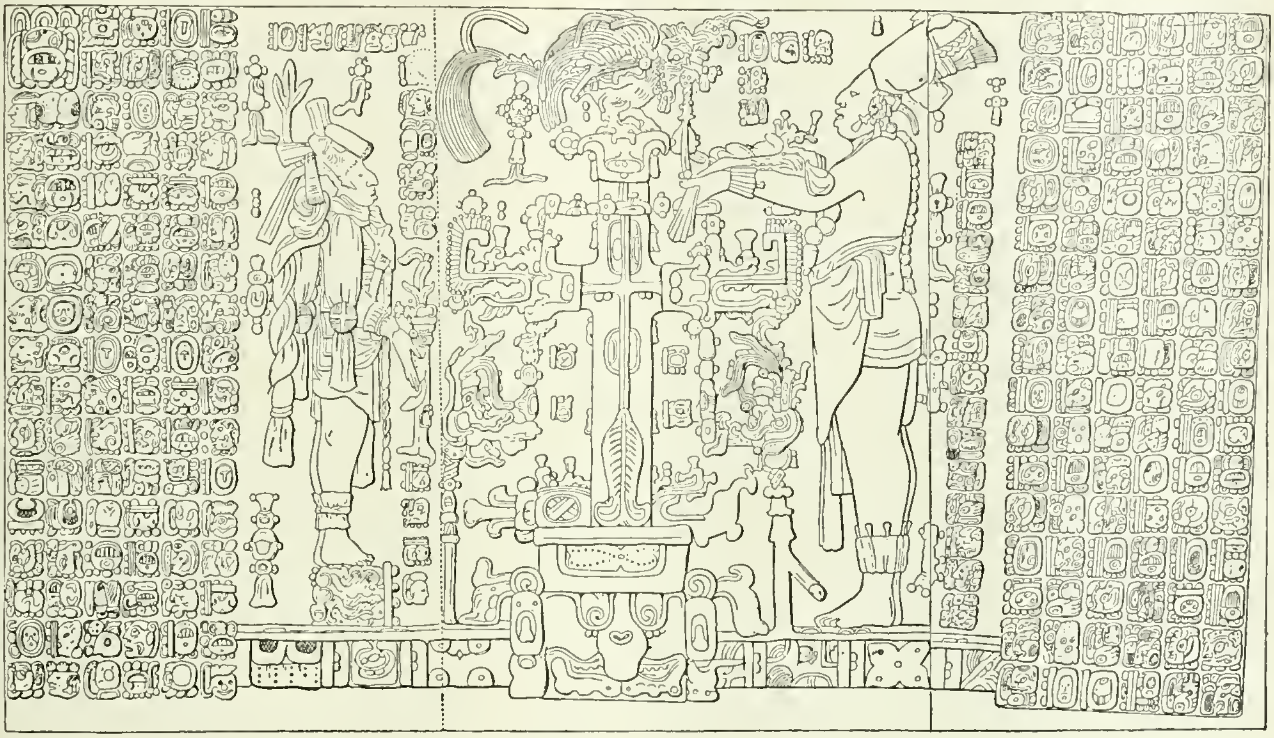

FIG. 3.—PRIEST OFFERING PASTE IMAGE OF AN INFANT TO A GOD IN THE SHAPE OF A TURKEY (PROBABLY GOD F).
The plumage of the turkey cock symbolised to the Maya the colours of rain on green vegetation. To the left stands an acolyte.

A deity of darksome hue appears in God L, known as "The Old Black God." In some of the pictures in the Codex Dresden his face is entirely black, but in the other manuscripts only the upper part of it is so painted. From the insignia which accompany him, I have been led to the provisional conclusion that he is in some manner connected with the synodical appearances of the planet Venus, which bulked largely

in Maya chronology as the basis of a time-count for the Calendar. He is also the fire-maker, who kindles the new flame with the fire-drill on the recurrence of the time-cycle.

The Maya's Mammon

In God M we have an even duskier deity, a patron of the native porters or coolies, and, like them, well-nigh black through constant exposure to the tropical sun. He has, in fact, an appearance almost negroid, thick, red lips, the lower drooping pendulously. He bears on his head a bale of merchandise secured by thick ropes. Occasionally he is drawn with the skeleton-like frame of the death-god, and this, and the circumstance that he usually carries arms, incline me to the belief that he is symbolical of the great risks run by the itinerant merchants of Mexico and Yucatan, who frequently acted as spies upon neighbouring tribes, or as the advance -guard of an invading army. He is, indeed, the god Ek ahau, or Ek chuah, "The Black Lord," a cruel and rapacious deity, whose general character reflects none too amiably upon the methods of Maya commercial activity.

God N, another aged divinity, is the god of the end of the year, and his headdress contains the sign for the year of 360 days. O is the only other goddess of the group, and her picture does not appear elsewhere than in the Madrid Codex. She also is depicted as advanced in years, and is usually represented as sitting at a loom. P, the last of the series, is easily to be recognised as the Maya frog-god, whose headdress, like that of God N, contains the sign for the year.

It is then possible to identify with reasonable likelihood six out of these sixteen figures, to label them with the traditional names they bore, and to fix the nature and characteristics of at least twice that number. This is certainly an advance, but it is not to say that we know all that is to be known regarding this galaxy of gods. The sources from which our information is drawn are tantalisingly obscure, but I would indicate two which I think have so far been insufficiently utilised. The monuments of Guatemala, Chiapas, and Yucatan contain numerous representations of deities, and these have as yet received only the most perfunctory attention. They must be more intensively examined and identified with, or differentiated from, the forms of the manuscripts. True, Maya art and its problems, and the elucidation of the hieroglyphic system, the surveying of temple sites, and the simplification of the calendar have occupied students more intimately. The other source to which they should turn is the folk-lore of the tribes of modern Yucatan, as recorded in such well-informed works as Professor Tozzer's *Comparative Study of the Maya and Lañcadoñe Indians.*

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Sleep and Sleeplessness

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What is Sleep?

Because a thing is very familiar it by no means follows that we know how it comes about. Possibly nothing in life is more familar than falling asleep, yet comparatively few people could tell us exactly what it is that makes people sleepy and finally permits the onset of sleep.

The fact is that healthy sleep is the result of the co-operation of several conditions or factors as physiologists call them. The most obvious thing about sleep is that, while it lasts, we are unconscious, dreaming being a more or less distinct interruption of this unconsciousness. On its mental or psychical side, then, sleep is a regularly recurring state of unconsciousness, lasting, on an average, about six to eight hours out of the twenty-four.

But this unconsciousness is the correlative of a condition of rest—inactivity—of the brain, of its most highly organised portion, known as the cortex cerebri. This cortex cerebri is the physical basis of consciousness, and therefore, when the cortex is active, consciousness is present, when it is inactive below a certain limit, there is unconsciousness.

The Rhythm of Sleep

This partial inactivity, like the unconsciousness it involves, recurs regularly, and, as physiologists say, rhythmically, i.e. at regular intervals. The rhythm of sleep is somehow related to the great cosmic rhythm of night and day, for towards nightfall animals and birds withdraw into the dark and rest, the only exceptions being those creatures of nocturnal habits—lions, jackals, owls, to name no others. A curious instance of this rhythm in regard to sleep is seen in the case

of a boy who was abandoned in the streets of Nuremberg at the age of seventeen. His childhood had been spent "in absolute solitude, having no knowledge of men, animals, or plants." He always went to sleep as soon as the sun had set.

There is no doubt that man is "intended" to rest his brain and his mind for about one-third of his life; and animals which hibernate or sleep during the winter spend one-half of their lives in repose.[1]

The Physiological Purpose of Sleep

Going to sleep is not a matter of choice; we *must* sleep just as we must eat to live; and in reality loss of sleep is more damaging than loss of food. This has been borne out by experiments and by the effects, both on men and animals, of periods either of starvation or of lack of sleep. Soldiers in the late war found lack of sleep more trying than lack of food. Sleep is therefore equivalent to some food; a person after the abstention from food of the eight hours' sleep is not nearly so hungry as a person who, awake, has not had food for eight hours.

In sleep not only is the grey matter of the highest part of the brain resting, but all the systems of the body are also relatively inactive. Thus the muscles are relaxed, the breathing is slower and shallower, the heart beats more slowly and less forcibly, the blood-pressure is reduced, the digestion is less active. Of course all this is relative; the centre for breathing in the highest part of the spinal cord cannot stop, nor can the kidneys or the liver—they are only less active than during waking; the complete cessation of their activity would mean death.

Young, immature animals sleep a very great deal; this is probably due to the fact that in immature organisms upbuilding of the tissues must prevail over disintegration, and this upbuilding in the brain has as its correlative the state of unconsciousness. Processes of repair, rest, restoration after fatigue in the central nervous system are related to sleep, so that we can understand how damaging to the nervous system must prolonged sleeplessness be.

Sleep and Death

Physiologically speaking, sleep is sharply contrasted with death. Sleep is restorative of vitality, death the extinguishing of it. We sleep to wake; we slumber in repose to work better on waking. And yet the poets see close resemblances between sleep and death, as is very well known.

Thus we have in *Macbeth* (Act II, sc. 3): "Shake off this downy sleep, death's counterfeit"; and again in *Cymbeline* (Act II, sc. 2): "Sleep, thou ape of death."

> "How wonderful is death,
> Death and his brother Sleep"

says Shelley in "Queen Mab." Tennyson, in "In Memoriam," calls sleep "death's twin brother." And Phineas Fletcher long before had said: "Sleep's but a short death, death's but a longer sleep," all following much more ancient writers. Far nearer the truth are the beautiful words of Jesus: "She is not dead but sleepeth."

Sleep is deepest in the first hour, somewhat less so in the second, and normally much lighter in all the others. This has been investigated by physiologists, who have measured the intensity of sound or of electrical shock necessary to awake a sleeper.

The Causes of Sleep: (1) Fatigue

As regards the causes operative in bringing on sleep, the first that would occur to us is fatigue. We cannot sleep if we are not tired in some degree. Sleep due to a healthy degree of fatigue is pleasant, as we are told in Ecclesiastes (ch. v, 12): "The sleep of a labouring man is sweet." In exactly the same strain speaks Belarius in *Cymbeline* (Act III, sc. 6): "Weariness can snore upon the flint, when resty sloth finds the down pillow hard." Fatigue is, on its material (objective) side, a mild blood-poisoning (toxæmia). During the waking hours certain soluble substances produced by the muscles, the nervous system, and other tissues get into the blood, and in traversing the grey matter of the brain greatly reduce its activity. These chemical fatigue-poisons are supposed to raise the resistance to the flow of impulses over the cells of the grey matter of the brain (cortex cerebri) to such an extent that the cells cease to be active, and therefore unconsciousness supervenes. Whatever be the exact mode of action of those poisons, there is no doubt at all that extreme fatigue can bring on the most profound kind of sleep known.

We may call this factor in sleep or type of sleep the chemical. As has been said, "we stifle our brain cells with the ashes of our waking fires."

There are many examples of sleep of chemical origin through great fatigue. Thus in the good old days of muzzle-loaders in the "wooden walls," some of the gun crew would, through sheer exhaustion, lie down beside the guns which continued the cannonade at their very ears.

Philip Gibbs, in his account of the retreat from Mons, thus describes this sort of thing: "Being attacked was the only thing that kept them awake. Towards the end of this fighting they had a drunken

[1] Very interesting examples of this were given by Sir Arthur Shipley in recent articles in DISCOVERY (vide the June and July issues).

craving for sleep, and they slept standing, with their heads falling over the parapet ; slept sitting, hunched in ditches ; slept like dead men where they lay in the open ground. In body and brain these men of ours were tired to the point of death. When called upon to make one last effort after six days and nights of fighting and marching, many of them staggered like men who had been chloroformed, with dazed eyes and grey, drawn faces, speechless and deaf, blind to the menace about them." This is an excellent description of the results of fatigue poisoning of the brain cells. It was so profound that the centres for hearing, seeing, and speech were benumbed, or as though narcotised.

The late Mr. Stevens told us how the camel-drivers in Lord Kitchener's famous forced march to Khartoum, overcome with fatigue, fell from the camels and slept on the sand while the rest of the Army Corps thundered past them. Sentries thoroughly fatigued have fallen asleep on their feet and remained standing ; postillions, in the good old coaching days, often fell asleep on horseback and yet rode on in the saddle. We recall that de Quincey wrote his "Vision of Sudden Death" after having been driven at thirteen miles an hour by a driver fast asleep on the box seat of a mail coach. More than once the cross-Channel swimmer, Holbein, has been noticed by the men in the boat to be swimming asleep. A friend of my own, a Colonel of Volunteers, told me that after undergoing twenty-two hours of extreme fatigue after the Great Review at Edinburgh in 1881, he walked home sound asleep for several miles along a familiar road in Fifeshire. This is not the so-called somnambulism, it is co-ordinated muscular activity during chemically induced sleep. A similar experience is related in Kipling's *Stalky and Co.*: "After that I went to sleep ; you can, you know, on the march, when your legs get properly numbed : Mac swears we all marched into camp snoring and dropped where we halted."

Extreme misery, stimulation, or the endurance of long-continued pain finally brings on sleep. In the good old days of torture, people used to fall asleep on the rack. A vivid instance of sleep after prolonged physical and mental pain—"bullying"—is also given in *Stalky and Co.*: "When Fairbairn had attended to me for an hour or so, I used to go bung off to sleep on a form sometimes." These sleep-producing fatigue substances have not been identified by physiologists, though attempts have been made to isolate them.

Whatever their exact chemical nature may be, there is no doubt that they are similar in action to the well-known vegetable alkaloidal poisons, morphine, nicotine, curare, and atropine, substances which interfere with the passing of impulses over the cell units of the nervous system. Hence there is related to this chemical factor in normal sleep the pathological type of sleep due to drugs—narcosis—whether the drug be bromides or ether, chloroform, alcohol, chloral, sulphonal, or any of the newer hypnotics ; hypnosis being but the Greek for "putting to sleep."

Lastly as to this factor we have the insomnia or sleeplessness from being "too tired to sleep." This insomnia may be due to the discomfort or pain arising from the over-exercised muscles, tendons, and ligaments, but some of it is due to the fatigue substances having an irritant instead of a hypnotic effect on sensory cells. Shakespeare, in the famous passage in *King Henry IV* (Act III, sc. 1), has contrasted the sleeplessness of the King owing to cares of state with the sound sleep of his humble subjects and also with the fatigue-produced slumbers of the tired-out sea-boy in such majestic language that the quotation of the lines will be pardoned :

> "How many thousand of my poorest subjects
> Are at this hour asleep! O sleep, O gentle sleep,
> Nature's soft nurse, how have I frighted thee,
> That thou no more wilt weigh my eyelids down
> And steep my senses in forgetfulness ?
> Why rather, sleep, liest thou in smoky cribs,
> Upon uneasy pallets stretching thee
> And hush'd with buzzing night-flies to thy slumber,
> Than in the perfumed chambers of the great,
> Under the canopies of costly state,
> And lull'd with sound of sweetest melody ?
> . . . .
> Wilt thou upon the high and giddy mast
> Seal up the ship-boy's eyes, and rock his brains
> In cradle of the rude imperious surge ?
> . . . .
> Canst thou, O partial sleep, give thy repose
> To the wet sea-boy in an hour so rude,
> And in the calmest and most stillest night
> Deny it to a king ? Then happy low, lie down,
> Uneasy lies the head that wears a crown"

(2) Absence of Sensations

The second factor productive of sleep is a negative one, the *absence* of sensations. Everyone knows we get off to sleep best when we retire into the dark, shut our eyes, and exclude as perfectly as we can the distracting sounds of the outer world. Rarely can we sleep in a bright light or in a noise, or if we are suffering pain ; sensations must be minimised or abolished. As we have just seen, in the sleep of extreme fatigue sensations are disregarded, but ordinary somnolence is brought about by a mild degree of fatigue co-operating with the more or less complete abolition of sensations. Any sensory stimulation can keep us awake—being too hot or too cold, or finding the bed-clothes too light or too heavy, or, of course, being in pain. This is the insomnia related to this second type of sleep. Cold feet—our own or someone else's—are a familiar cause of sleeplessness.

The onset of sleep as due to the withdrawing of

sensations is strikingly shown in a case known as "Strümpell's boy." This boy, aged sixteen, living in Leipzig, suffered from the following defects: He was insensitive to touch, he had no sense of smell or taste, he had no muscular sense, no sense of pain, and, finally, he was deaf in the right ear and blind in the left eye. When his left ear was stopped up and his right eye bandaged, he fell asleep in two or three minutes. This negative sensory sleep factor is virtually the *not* engaging of consciousness with sensory activity.

Now the existence of long-continued, not too intense sensory stimulation comes to the same thing practically as not engaging the attention at all. Thus droning reading or preaching ceases in time to engage the attention, and we fall asleep. Any long-continued sensation which does not change in intensity—contact of our clothes, the presence of still air at the temperature of the body—ceases to be a stimulus at all. Thus we can sleep in the rattle of a train or the creaking of a steamer, but as soon as either stops we wake up. The change from noise to no noise is the stimulus. Hence a person accustomed to sleep in the din of a city, often cannot get off to sleep the first night in the country—the stillness of the country being by contrast the stimulus itself.

Before we leave the second factor we might note that in the unconsciousness of deep sleep pain itself is abolished for the time being in the sense that an unconscious brain cannot perceive pain. Our chief trouble is to induce sleep in cases of great pain (neuralgias, tic douloureux, sciatica, etc.), but, having induced it, we know that the patient will obtain complete relief. Hence Shakespeare is quite right when he says: "He that sleeps feels not the toothache" (*Cymbeline*, Act V, sc. 4). Of course this is equally true of mental pain:

> "Come sleep . . . the balm of woe,
> . . . the prisoner's release"—

says Sir Philip Sidney in *Astrophel and Stella*. In the same strain, Shakespeare declares—

> "'Sleep no more! . . .
> Macbeth does murder sleep,' the innocent sleep,
> Sleep that knits up the ravell'd sleave of care,
> The death of each day's life, sore labour's bath,
> Balm of hurt minds, great nature's second course,
> Chief nourisher in life's feast."
> (*Macbeth*, Act II, sc. 2).

(3) Absence of Thought

Very closely allied to the absence of sensations as a cause of sleep is the third factor, the absence of thoughts, emotions, ideas, any cerebral activities, in fact. Everybody knows that anything that is on the mind will prevent sleep, whether it be joy, grief, or an unsolved mathematical problem. Thoughts we cannot banish keep us awake; the tranquillity of a mind at rest, at ease, "at leisure from itself" conduces to sleep. It is the insomnia related to this third factor that is so familiar in the sleeplessness of a "bad conscience," as it is jocularly called. It is mental activity, of course, which keeps children awake after their first visit to the menagerie, pantomime, or "hall of mysteries." The personal factor here is interesting; some people pass a sleepless night if they know they have to get up earlier than usual next morning; some condemned criminals have slept soundly the night before their execution. As long as the mind is obsessed, sleep is impossible. Sleep means inactivity of the brain, thoughts involve its activity, therefore thoughts and sleep are mutually exclusive.

> "Care keeps his watch in every old man's eye,
> And where care lodges, sleep will never lie."
> (*Romeo and Juliet*, Act II, sc. 3.)

Wordsworth described this insomnia of the third factor well when he addressed sleep as "Still last to come where thou art wanted most."

(4) Less Energetic Circulation

We may now inquire into the fourth and last cause of sleep, which is the diminution in energy of the circulation of the blood in the brain. Functional activity of a part depends on a certain amount of blood supplied to the part; in health the more blood an organ gets the more active it is. The brain is no exception; as its blood supply falls off, its activity is diminished until at last sleep supervenes.

Some of the evidence that the blood-supply of the brain is reduced in sleep is direct. It has been noticed through a wound of its skull that the brain (cortex cerebri) of a dog becomes paler during sleep. Physiologists have trephined the dog's skull and inserted a glass window into the aperture. They have noticed that when the dog fell asleep the surface of the brain not only became paler but receded from the glass, which previously it had pressed upon. Every mother knows that in the infant's head there is a membranous spot (the anterior fontanelle) which moves up and down with the same rhythm as the child's breathing.

Obviously the more blood in the child's brain, the more will this membrane bulge up; now it can be seen that this membrane is depressed during sleep and raised during wakefulness. When the child cries, and so prevents the veins from the head emptying their blood easily into the heart, the blood so dammed back causes the fontanelle to bulge upwards.

The Russian physiologist, Tarchanoff, has proved

that the only position in which puppies cannot go to sleep is that in which their heads are kept lower than their bodies. The retina in the interior of the eye is a part of the brain ; if the retina be examined with the ophthalmoscope by someone who is familiar with the blood-supply of the eye of a waking person, it will be found in sleep to be distinctly paler.

The rest of the evidence is more indirect, but to the physiologist equally cogent. The Italian physiologist Mosso contrived to make a man go to sleep balanced accurately on a plank or table ; as the man fell asleep the end of the table where the feet were dipped down through an angle corresponding to about the weight of 260 c.c. of blood. Evidently this is due to a redistribution of the blood, there being relatively less at the head end and more at the feet end of the body.

This redistribution of blood during sleep may be studied in yet other ways. We all know that the skin is flushed in sleep, noticeably so in children and persons with transparent skins—hence the "sleeping beatuy"—but this means that if now the skin holds more blood, the brain will be holding less.

A Russian physiologist has proved that the pressure in the carotid arteries of dogs asleep is less than during waking. The American physiologist Howell has proved, by a delicate apparatus in which he enclosed the arm of a sleeper, that as he fell asleep the blood in the arm was increased, and therefore had been diminished in the brain. It seems clear, then, that the cutaneous and cerebral blood supplies can vary simultaneously in opposite directions.

But the skin is not the only place where the blood which is leaving the brain may be found ; some of it may be accommodated in the internal organs, especially those of digestion. One has only to recall the sleepiness that many people experience after a full meal, for the simple reason that the stomach in active digestion needs a great increase of blood which it must withdraw from the brain.

In the last analysis it is the fall of blood-pressure in the vessels of the brain which is the vascular factor leading to somnolence, and therefore anything which reduces the pressure tends to sleep. Thus before an attack of sea-sickness blood is leaving the head, as is shown by the pallor of the face ; most of us know that we feel decidedly sleepy before the vomiting occurs. Persons exposed to extreme cold become very sleepy through the enfeeblement of the heart devitalised by the low temperature. Old people, owing to the weakness of their cerebral circulation, often drop off to sleep, especially when tired and in a sitting posture. This was noticeably so during the last few months of the life of Queen Victoria, who would frequently be found asleep in the carriage on her afternoon drive.

Evening, and its Accompaniments

We may now ask ourselves why it is that as evening comes on the skin and intestinal organs are accommodating relatively more blood than earlier in the day. The answer is that the small arteries of these systems are losing some of the tone they had earlier in the day. Most people have noticed their collars, rings, etc., feel tighter towards evening. Vessels whose tone is diminished dilate, and therefore hold more blood than before ; in this way the dilated vessels of the skin and viscera accommodate blood which was previously in the brain, and therefore sleep results.

Finally, it may be asked, "Why do these vessels dilate towards evening ?" The answer is, the nerve centre whose duty it is to keep them partially contracted is somewhat fatigued and fails to keep them as fully constricted as it did earlier in the day. The insomnia related to this vascular factor is very familiar. If the heart is beating too rapidly and strongly, it maintains so vigorous a flow of blood through the brain that the cells there are kept in a state of activity which, as we have seen, is incompatible with sleep.

Anything which spurs on the heart to increased effort is inimical to sleep. Thus the stimulant effects of violent exercise, of certain drugs, of not excessive quantities of alcohol, of blood raised one or two degrees in temperature, are all in the direction of banishing sleep. The well-known hypnotic effect of alcohol in hot water (toddy), or of hot milk, or of hot milk and alcohol is entirely due to the vascular factor, for these warm foods cause so abundant a dilatation of the vessels of the stomach that blood is withdrawn from the brain and somnolence ensues. The mere fact of going to bed hungry is a source of sleeplessness due to the positive sensory factor, i.e. hunger ; but the partaking of a particularly indigestible meal shortly before bedtime is, by reason of the unusually violent muscular movements aroused in digesting it, a much more serious source of a sleepless night.

A hot bath, in that it dilates the vessels of the skin and so lowers cerebral pressure, is an excellent hypnotic ; and the Turkish bath with its subsequent massage is still more soporific.

What Causes Insomnia ?

It is extremely probable that the onset of healthy sleep is due to the co-operation of all the four factors which we have discussed. Thus the mind being free from too obtrusive thoughts and sensations, and there being a certain degree of brain fatigue, a fall of cerebral blood-pressure occurs and the person falls asleep.

The reversal of any of these four conditions—psychic, sensory, fatigue, or vascular—will involve the corresponding insomnia.

Of course any given attack of sleeplessness may be due to the co-operation of two or more sleep-banishing factors. Thus if a person is in a state of emotional unrest, this condition acts on the heart, stirring it up to increased effort, with the result that an insomnia is produced which *could* have been produced by either factor alone.

Varieties of sleep related to the vascular factor are the condition in fainting (syncope), and that brought on by compression of the carotid arteries—a method successfully used to induce sleep in a maniac; both, of course, are abnormal, or, as we say, pathological.

This is not the place to enter upon the hygienic aspect of sleep and sleeplessness; but we must allude to the devitalising effects of fatigue especially when coupled with sleeplessness. Both predispose us to ill-health, in that they reduce the resistance of the organism to the onslaughts of the micro-organisms that cause disease.

The new-born infant sleeps much; its brain is too immature to perform the functions of full working life, and so more than one-third of its life is passed in sleep. At the other end of life's drama it happens most often that the curtain falls while we sleep, so that Shakespeare was doubly justified in exclaiming, "Our little life is rounded with a sleep."

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Animal Fecundity—II

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In considering the factors which control the quantity of offspring produced by animals, it must be borne in mind that the fertilised egg cell, whether of a fish or an insect or any other animal, is the product of union of a single ovum or female reproductive cell with a single sperm or male reproductive cell. The egg, as a consequence of this process, becomes endowed with a new vitality, whereby it is rendered capable of undergoing that long series of cell divisions which results in the full development of a new individual organism. Now in the higher animals the number of eggs which are shed from the female reproductive gland is limited, in some species only a single egg being discharged at a time. In the male animal, on the other hand, the number of reproductive cells produced and shed from the generative gland runs to many thousands, the purpose being to increase the chances of the ovum becoming fertilised; this is an example of the extraordinary prodigality of Nature in seeking to accomplish her ends, the ultimate object in this case being the perpetuation of the race.

Fecundity of Domestic Animals

Among the domestic animals, the mare and the cow usually discharge only one ovum at a time, and upon this depends the fact that with these species only one young one is usually produced at birth. With the rabbit, on the other hand, there are sometimes as many as eight ova shed synchronously from the reproductive gland, and in the pig as many as fifteen or even twenty or more ripe ova are produced. Upon this depends the well-known fact that these animals often produce large litters, the number in each litter generally corresponding closely, but not necessarily exactly, with the number of ova discharged. Since the number of male cells produced is, as a rule, extremely large, it follows that, generally speaking, the female is a more important factor in the quantity of offspring produced than the male. This rule, however, is not invariable, but in a large percentage of instances it is certainly correct.

Methods of Increasing Fecundity in Sheep

In the sheep the normal number of ova discharged at a time is not appreciably in excess of the average number of births at the lambing season. This number is most frequently one, but quite commonly two, and sometimes three, but any greater number is unusual. There is direct evidence that in the sheep, as in other mammals which have been studied, a considerable number of ova die within the reproductive gland, and that this may happen at all stages in the development of the ova. Scarcity of available ova at the "tupping" or breeding season may be due either to a retardation in the growth and maturation of the ova, or to an excessive proportion having perished at some previous time, and both conditions must be ascribed to a former want of sufficient suitable nutrition. On the other hand, a favourable nutrition, especially in the period immediately preceding "tupping time," causes a larger number of ova to develop and so to become available for fertilisation, and as a consequence increases the number of births at the succeeding lambing season. What is really the practical application of this fact has been long recognised by many flockmasters, who have practised the methods of "flushing" or artificially stimulating their ewes by means of an extra supply of special food at the approach of the "tupping" or breeding season. Several years ago the Highland and Agricultural Society of Scotland

undertook an inquiry upon this subject and accumulated a quantity of statistical evidence extending over three years for flocks of Black-faced, Cheviot, Border Leicester, and cross-bred sheep. The records collected clearly showed that sheep which were fed upon oats, maize, dried grains, or turnips or other additional food at the time when the rams were turned out to the ewes and for about three weeks previously, but which were maintained upon grass only for the greater part of the year, had a better crop of lambs than sheep which were not subjected to such treatment. The percentage of twin lambs born was very perceptibly increased. Merely putting ewes upon superior pasture for a short time before "tupping," and without any special feeding, was often sufficient to increase the fertility of the flock. Among "flushed" flocks of Border Leicester or half-bred Border Leicester ewes the number of lambs per ewes was nearly 200 per cent., while for sheep of the same breeds which were not so treated the average proportion of lambs per ewes was between 150 and 160 per cent. The best condition for the breeding ewes was a good thriving or "improving" one, an excess of fat being as detrimental to fertility as a too lean condition. The effect of the practice of "flushing" or nutritive stimulation is clearly to increase the number of ova discharged at a time. Once the process of discharge is accomplished, no amount of extra feeding can increase the number of developing young, for this number is determined at the time of "tupping." An adverse circumstance during the period of gestation may reduce the crop of lambs, but favourable conditions at this season can do nothing to increase it if a sufficiency of mature ova has not previously been produced.

Influence of Male Parent

It is thus seen that in a certain sense the female parent is often a more important factor in fertility than the male, since the female usually controls the size of the litter. There is, however, another sense in which the male parent may be regarded as the more important factor. It is usual for a good stallion to mate with eighty or more mares in a season, and for a ram to mate with about fifty ewes. It is obvious, therefore, that any failure in the power of procreation on the part of the male parent may cause temporary sterility in a large number of females, and such an effect is by no means an unknown occurrence. Again, it has been sometimes found that a female who is barren with one male will be fertile with another. Thus Dorset Horn ewes, which fail to breed when put with a Dorset Horn ram, may subsequently produce lambs after mating with a Hampshire Down ram. Furthermore, Mr. John Hammond, of Cambridge, has shown that with sows the activity of the female generative gland may outstrip the capacity of the animal to produce fully developed piglings, and that a certain number of these may die and degenerate before being born. The cause of this phenomenon is still under investigation, but it seems probable that it is a question of nutrition.

Inheritance of Fecundity

Fecundity, like other characteristics, may be hereditary, and some breeds are notoriously more fertile than others. Thus among sheep the Dorset Horns are far more prolific than sheep belonging to hill breeds, even though the latter are bred amid lowland conditions. Moreover, by breeding from sheep which were twins the fertility of a flock may be increased, and the capacity to bear twins can be transmitted through the ram to the next generation of ewes of which that ram was sire in just the same kind of way as the deep-milking propensity of some cows may be transmitted through the bull to the next generation of female calves. So also Pearl has shown that the capacity to lay an increased number of eggs possessed by some strains of fowls may be transmitted through the cock.

Among the Stars

An Astronomical Commentary

The Total Eclipse of September 10

The astronomical event of the month will be the total eclipse of the Sun on September 10. The shadow of the Moon will strike the Earth's surface in the North Pacific Ocean, just off the coast of Asia. It will then cross the Pacific, traversing the American continent by way of California and Mexico and ending in the Atlantic, just off the northern coast of South America. As the eclipse will be the most favourable visible on American territory for over twenty years, it will be extensively observed, and numerous expeditions are being fitted out by the various American observatories. The Lick astronomers will be stationed at Ensenada, and the Mount Wilson observers at San Diego, while the Yerkes Observatory station will be on Catalina Island.

In recent eclipses, the chief object of observation has been to subject the Einstein theory of relativity to observational tests. In view of the results attained last year, however, this question may now be regarded as settled in favour of the theory, and accordingly other problems which in recent years have fallen into the background will come in for their share of atten-

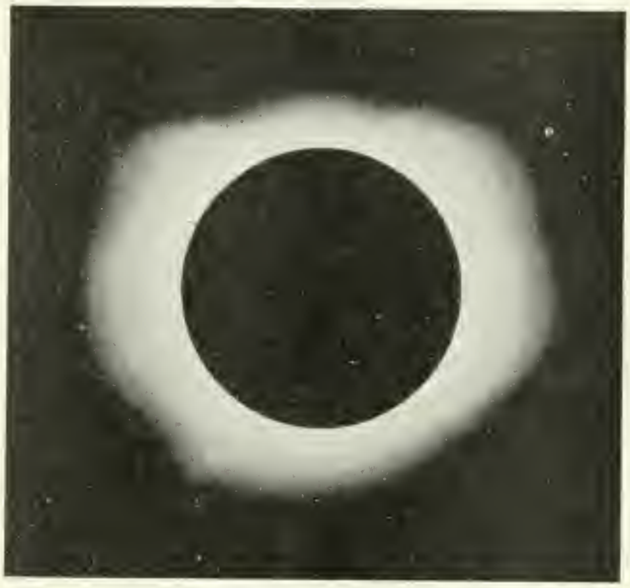
tion. First of all is the nature of the corona. Alone of all the solar appendages, the corona has defied the advance of spectroscopy and can only be observed on the rare occasion of a total eclipse. As Mr. Fath, of Goodsell Observatory, Minnesota, remarks: "We know that a portion of its light is polarised, that its spectrum consists in part of reflected photospheric light and in part of bright lines, that it rotates in the same direction as the Sun, and that its general outline changes with the sun-spot curve. We know practically nothing of the forces which determine the direction of its streamers; nothing of the real nature of the substances composing it, their source, or their motion in the streamers; nothing about its rotation except direction." Another problem is that of the existence of intra-Mercurial bodies. While it is certain that there are no objects of planetary dimensions beween Mercury and the Sun, it is not improbable that a number of asteroidal bodies may exist. Accordingly, it will be desirable to explore the solar vicinity with powerful instrumental aid. An interesting feature of the coming eclipse will be the presence of Venus in the near vicinity of the sun. Indeed, it will be possible to photograph the planet on the eclipse plates. Mr. J. H. Worthington remarks, in *Monthly Notices*, vol. lxxxiii, p. 424, that "it seems that Venus shining through the outer corona and an immense section of the zodiacal light on this occasion should offer an opportunity to study the absorption spectra of these solar appendages."

Another New Star

Mr. Lampland, of the Lowell Observatory, Flagstaff, Arizona, discovered a new star on May 5 last. The nova is situated in the spiral nebula Messier 83 (N.G.C. 5236) and is of the fourteenth magnitude. The nebula is described by Dr. Curtis, of the Lick Observatory, as a large and beautiful spiral with a very bright nucleus. This nova is evidently another of these remarkable outbursts in spiral nebulæ, of which many have been catalogued in recent years.

Dr. Anderson's "Nova Cygni"

Dr. T. D. Anderson informs me that he feels "pretty certain" that the nova whose discovery he announced three months ago is to be identified with the star B.D. 35° 4505, a star of the ninth magnitude, which is an easy object in a $2\frac{1}{2}$ or 3 in. refractor. Dr. Anderson has been informed by Professor Shapley that this star is of spectral class Ao—"that is to say, it comes spectroscopically under the same category as Sirius and Vega." Professor Shapley "is engaged along with his staff in examining the photographs on which B.D. 35° 4505 appears in order to ascertain if there was any earlier outburst. I rather think the result of the search is proving to be negative." Dr. Anderson remarks that since its outburst, the nova has remained in a state of quiescence, and he maintains that the outburst has been a comparatively slight one. Can we, with the facts before us, he asks, "make bold to conclude that if novæ brighten up to the extent of only a few magnitudes, their subsidence will take only a short time and that that time will be very short indeed if the star's increase in brightness has been very small?" Dr. Anderson is so skilled an observer that his suggestion is worthy of serious consideration. Professor Turner probably voices the opinion of the astronomical world when he says that we may accept Dr. Anderson's statement as to his discovery "without hesitation,"



TOTAL ECLIPSE OF 1914, SHOWING CORONA.
Reproduced, by permission, from the "Monthly Notices" of the Royal Astronomica Society.

and that "we can scarcely doubt that he has indicated the right sort of explanation."

The Densest Known Star

The American astronomer, Mr. F. C. Jordan, announces the discovery of a remarkable eclipsing variable star. The period of variation from maximum to maximum or minimum to minimum is a little less than six hours. Like other eclipsing variables, the star is a binary or double; and a study of the light curve indicates that the components of this binary are dwarf stars of high density and elliptical in shape. The two stars being approximately equal in size, it is possible to compute the upper and lower limit values for the mean density, which Mr. Jordan finds to lie between 3·4 and 2·2 times the density of the sun. This star is, therefore, the densest star

known. Its period is in addition the shortest among eclipsing variable stars.

Death of the Cape Astronomer

There will be real regret among astronomers at the premature and unexpected death of Mr. Hough, His Majesty's Astronomer at the Cape. The Cape Observatory occupies quite a unique place in astronomy, and has been presided over by a succession of very able observers. Thomas Henderson, afterwards Astronomer-Royal for Scotland, carried through at the Observatory his parallax measures of Alpha Centauri. Maclear, his successor, continued the work and determined the distance of Sirius. In 1879 Mr. Stone was succeeded by the late Sir David Gill, under whom the Cape Observatory reached its pinnacle of fame, becoming the centre of activity for the photographic charting of the heavens. Mr. Hough succeeded Sir David Gill on the latter's retirement in 1907. Under his directorship the high traditions of the Observatory were fully maintained. Mr. Hough was a mathematician of considerable powers, and in 1897 and 1898 he carried through a highly important piece of work—the revision of Laplace's theory of the tides, which Sir George Darwin pronounced to be "the most important contribution to the dynamical theory of the tides since the time of Laplace." In collaboration with Dr. Halm, Mr. Hough exhaustively investigated the solar motion and the streaming of the stars.

HECTOR MACPHERSON.

Reviews of Books

THE REVELATIONS OF CRETE

The Minoans. By GEORGE GLASGOW. (Jonathan Cape, 4*s.* 6*d.*)

Many a traveller who has "gone east" across Italy and the Mediterranean will not readily forget how he watched from the deck of his ship the long, southern coast of the famous island which, so to speak, shuts off the Ægean Sea from the larger sea. Seen from twenty to thirty miles away, Crete's southern coast rises with magnificent abruptness out of the blue waters, finally ascending into lofty ranges with jagged peaks cloaked in snow or rendered half visible by clouds. A still more fortunate traveller is he who has taken ship along the northern coast, gazing at the green plains, studded with white villas, which recede towards the towering background of the island's mountain range, of which Mount Ida is the culminating point. It is difficult to imagine a more romantic-looking island than Crete, and to land on it is to gain impressions of mixed civilisations and religions—Turkish, Greek, and Cretan—jostling into each other amid surroundings of extraordinary beauty.

In a word, Crete is the very kind of island to provide an admirable setting for excavations leading to romantic revelations of a past epoch in the world's history. Only twenty-three years ago Sir Arthur Evans started to dig on the island, since when his own excavations and the excavations of other archæologists at Knossos, Phæstos, and other sites have disclosed, as Mr. Glasgow remarks in his opening chapter, "the existence of a people whose form of civilisation, the earliest in Europe, flourished long before history begins." This island civilisation has been established almost beyond doubt as the connecting link between the great civilisations of Egypt and of Greece. Thus within little more than two decades enormously important facts have been revealed to us which place the history of mankind in altogether new proportions. Instead of regarding the wonderful era of Greek civilisation, which lasted from about 800 B.C. to about 140 B.C., as some exotic and sudden growth, which had only slight and uncertain relations with the earlier and more materialistic civilisations of the East, we now know that this age owes a great debt to the religions and culture of the ancient Egyptians, which were passed on, being amplified in the process, through Crete to the European mainland.

Sir Arthur Evans has for several years past been recording the results of his excavations in large volumes; other archæologists have also described their work in various books. The value of Mr. Glasgow's present account, however, the substance of which was published in 1920 and 1921 in DISCOVERY,[1] lies in the fact that it gives to the ordinary reader a comprehensive, up-to-date, and concise description of the excavations and their importance in relation to the progress of civilisation. Indeed, the careful research which has gone to the making of this book is matched by the lucid manner in which that research has been expressed in writing. The age when Crete was a centre of Mediterranean civilisation begins about 2800 B.C. and ends about 1100 B.C. Thus it flourished during the Bronze Age, though man first settled in Crete at a place called Knossos during the later Stone Age, gradually moving across the island to the south side and founding colonies, such as that at Phæstos, where pottery of a superior kind to that at Knossos has been found.

It must not be imagined that Crete merely handed on the torch of culture from Egypt to Greece. Minoan civilisation is marked by definite characteristics of its own. "After Schliemann's discoveries at Mycenæ and Tiryns," as the author indicates, "the term 'Mycenæan' was used in a general sense to cover the whole prehistoric Ægean civilisation; but, now that Crete has put Mycenæ into its right perspective, the term 'Minoan' is used to indicate the earlier and greater phase, while 'Mycenæan' merely covers the latest phase; the whole being designated 'Ægean.'" Professor Elliot Smith is careful to emphasise the fact that "at the dawn of civilisation Crete occupied a unique situation, which was exceptionally favourable to the development of a high culture; and there can be no doubt that she seized her advantage and turned

[1] See DISCOVERY, vol. i, nos. 6, 8, and 10, and vol. ii, nos. 13 and 14.

it to the most profitable account. Her geographical position as a sea-girt isle was such that, while being exempt from the dominating and overshadowing influence of Egypt, she profited by both of the fertilising streams of inspiration that had their source in Egypt."[1] Neither did Crete owe the origins of her culture entirely to Egypt, for, as the same authority shows, she "was also affected in a most intimate way by the eastern (northern) stream of culture from Asia Minor, where the influences of Mesopotamia and Syria were blended with that of Egypt."

Let us for a moment examine some of the features of Cretan culture. The palace unearthed at Knossos is an amazing structure. In reality the ruins consist of three palaces built up one on top of the other. The topmost palace, in which the Cretans reached the height of their architecture, was "a square building covering about five acres, or as big an area as Buckingham Palace, and had a flat roof. In shape it was a hollow rectangle, with a central court, measuring nearly two hundred feet from north to south, and not quite half as much in breadth. . . . Beyond the west wing there was another court—the meeting-place for the people of the town and the people of the palace; and out to the north-west a smaller building—the Little Palace—connected with the palace proper by what Sir Arthur Evans has called 'the oldest paved road in Europe,' while a little to the north-east was the Royal Villa." Near the palace was a theatre, whose rising tiers of steps and raised platform have been brought to the light of day. The palace walls were built of gypsum coated with lime-plaster. The palace's system of draining was extremely elaborate. Into the many details of its architecture we cannot enter here. The contemporary palace at Phæstos, excavated by the Italian Archæological Mission, must in many ways have equalled the magnificence of that at Knossos. It was built on a smaller scale but, like Knossos, "consisted roughly of a system of buildings grouped round a central court."

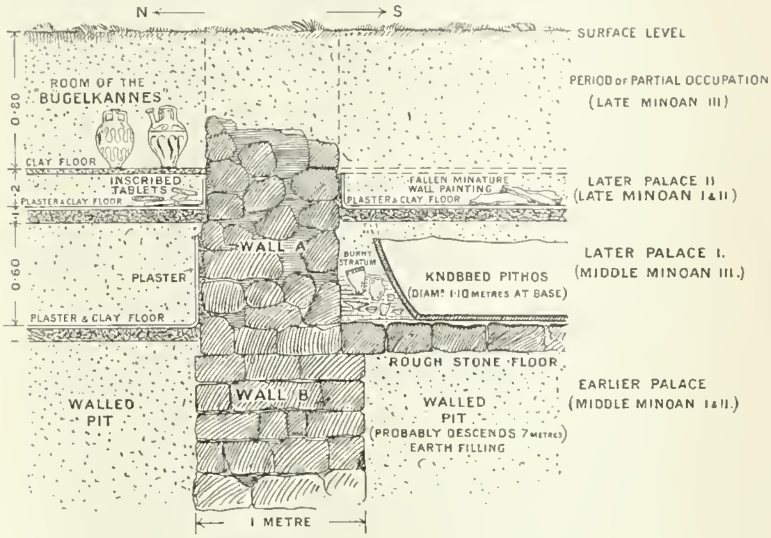
Passing over the ruins of humbler dwellings, with their interesting equipment of lamps and other furniture, mention must be made of the pottery, which has been of great use for determining dates. It displays a wonderful sense of beauty, even amongst the Stone Age predecessors of Crete's Golden Age; the pottery of the Middle Minoan Period (around 2000 B.C.), with its brilliant colourings and beautiful curves, could not be bettered on to-day, even if it was imitated. Many specimens of fresco-painting and relief work on the lime-plaster of the outer walls of buildings have been found. In the case of fresco-painting brilliant colours were used; these specimens do not equal the Egyptian methods for elaborateness of detail, but they give a more vivid impression of movement.

Lack of space forbids us to describe the religion, clothing, and social customs of this wonderful island race. The Minoan ladies wore open necks and flounced skirts, and of them a certain French scholar, on seeing some art relics, exclaimed, "Mais ce sont des Parisiennes."

[1] *The Ancient Egyptians.* New and revised edition. (Harper Bros., 6*s.*)

The Minoans, it may be assumed with fairly considerable certainty, belonged to what archæologists term the "Mediterranean" race; they, therefore, had "long" heads, oval faces, dark skins, hair and eyes, and, in general, small, but well-developed bodies.

STRATA SECTION FROM PALACE OF KNOSSOS.



(From R. M. Burrows's *Discoveries in Crete.*)

Many questions remain to be cleared up in this field of archæology. We have very scanty details of the relations, commercial and cultural, between Egypt and Crete. We have still less knowledge of how the Minoan civilisation reached Greece. There is a gap of 600 years between the fall of Knossos and the first recorded Greek history, about 800 B.C. Most exciting question of all, "Will the writing of this island race, preserved on hundreds of clay tablets, be solved?" Its solution would not merely go far to answer the preceding questions; it would throw new light on the early history of civilisation and result in as amazing revelations as those effected by the discovery of the famous trilingual Rosetta Stone in Egypt in 1799. Solutions turn up in weird, unexpected ways; it is, for instance, within the realms of possibility that a stone or papyrus giving ancient Egyptian and Cretan equivalents in writing might be found in Tutankhamon's tomb in the autumn, or that some chance traveller in Greece might find a clue from a Greek-Minoan inscription. Who knows?

EDWARD LIVEING.

THE PROBLEM OF CANCER

Theories and Problems of Cancer. By CHARLES EDWARD WALKER, D.Sc., M.R.C.S., L.R.C.P.

There can be no question but that the widest possible dissemination of knowledge on problems of public health is in the best interests both of the medical profession and the community. It used to be said that every man over forty was a fool or a doctor; it might be added

that every educated adult man and woman should know at least as much of medicine as they do of public affairs.

This book, a reprint of articles published in *Science Progress*, with additional matter to bring it up to date, is to be recommended, especially at the present time, when a concerted effort is being made to solve the problem of cancer, as a useful introduction for the general reader to the essential features of malignant new growths of the body. We are composed, all of us, of countless millions of unit structures, known as cells, each with individual characteristics, which render them recognisable to the microscopist. Normally, these cells work, grow, and die in an orderly, well-organised manner, duly considering the interests of their neighbour cells like citizens of an unusually disciplined state. The cancer cell—arising from some such normal, healthy ancestor—passes out, in the author's phrase, of "Somatic co-ordination," grows its own way without regard to the interest of other cells, which it strangles and kills with the energy of a raiding band of savages in a fertile country.

The author pays some attention to the supposed variation from the normal of these cells as regards their intimate structure. When a cell divides, and so reproduces itself, its central portion, or nucleus, wherein reside the essential vital features of that cell, splits up into a definite and constant number of strands of dark-coloured tissue, known as chromosomes. This number is the same for all the cells of any one species of animal; there are, for instance, thirty-two such strands in man and twenty-four in the newt. There is only one exception in normal cells, namely, the sex-cells, male and female, which have each only half the normal number of chromosomes. Dr. Walker produces evidence that cancer cells also have only half the normal number. No one who has not studied this particular question is entitled to express an opinion, but it should be remarked that these observations, due to the author himself, have been widely criticised, as he himself points out.

A discussion of the theories that cancer falls into line with diseases such as tuberculosis, and is due to a parasite of some kind, or to various parasites, also occupies a portion of the book. Innumerable features of cancer are absolutely inconsistent with the action of any parasite resembling the bacteria which cause infectious diseases, not least the fact that cancer is not infectious. Of course, the question cannot be settled until the true nature of the disease is demonstrated.

Cancers can be grafted from one individual to another, and this has been done many hundreds of times in mice. But little has come of these experiments, and the resulting growths are not entirely comparable with cancers of natural occurrence.

The cause of cancer is unknown, and the cure, save by early and extensive operation, impossible in practically every case. Sometimes—once in a doctor's experience—a cancer disappears of its own accord; but when it seems to do so, the probabilities are vastly in favour of the diagnosis being wrong. Some facts are known. Prolonged irritation, such as X-ray workers, chimney-sweeps, paraffin workers, and those with decayed teeth cutting the tongue, are subjected to, will lead to cancer. There are as many theories of causation—the eating of every single article of diet, insufficient eating of every article of diet, clothing, washing, and even a wrong mental attitude—as there are ill-informed writers and talkers on cancer. If this book serves to impress the baffling nature of cancer, and the need of the earliest possible recourse to surgical aid on a wider section of the public than is at present familiar with this urgent question, it will have done a work of great value.

R. J. V. P.

PSYCHOLOGICAL TYPES

Psychological Types. By C. G. Jung, Dr. Med. et Jur. of the University of Zurich. (Kegan Paul, 25*s*.)

The publication in English of a work by Dr. Jung is a welcome and important event, for although it is fairly generally known that what has been called the "new psychology" includes several schools of thought, yet by far the greater amount of literature has been produced by the Freudian school, and in consequence there has been a tendency on the part of the general public to confuse the work of the Zurich school of Dr. Jung with "psycho-analysis," a term that can only be properly applied to the well-defined theories and method of Professor Freud and his followers.

In a preface to the present volume the translator, Dr. Godwin Baynes, explains the difference between the philosophy of Professor Freud and Dr. Jung, but ventures farther and rather unfortunately into the "troubled waters of controversy" in criticising Professor Freud's theories, which he does not present very accurately.

Dr. Jung is more moderate and impartial; he puts forward a classification of human types, with the reservation that it is not intended to be final or exclusive, and that, viewed from other angles, the same types might be grouped differently. The main line of classification is that already put forward by him (in *Papers on Analytical Psychology*) into two "general attitude types," the intravert and extravert. This is a distinction that, when well marked, is easily recognised; the intravert tends to live an "inner," reflective life, the extravert tends to live in "doing," and his interest flows out freely into his environment. Here we may mention Dr. Jung's contention that the Freudian school tends to take the extravert attitude as a standard of normality, whereas the Zurich school regards both intravert and extravert as two normal and probably innate ways of adaptation to life.

In the present volume a further classification is proposed according to the predominance as a guiding element in life of one of the "basic functions" of *thinking*, *feeling*, *sensation*, and *intuition*. Each of these four types may be either intraverted or extraverted, so that the classification is finally into eight separate types.

It might perhaps be said that not much has been gained by mere classification, but Dr. Jung proceeds to show that the predominance of one function is liable to involve the repression of the others and result in a one-sided personality and a faulty adaptation to life.

The repressed functions are not, of course, abolished, but are unable to play an adequate part in conscious life, so that the "unconscious" tends to have (for all individuals) a compensatory function. This implies that, where the personality has become one-sided owing to a great predominance of one function, the balance may be restored by bringing the unconscious elements to light by a process of analysis.

There is a further value to be gained from a better understanding and appreciation of the different types, for time and again the view has been brought forward, a little helplessly, that the clash and bitter opposition between people who "take a different view" of the same facts is due to some personal factor of which neither party is aware. Dr. Jung explains the nature of this personal factor and points the way towards a solution of the barrier of misunderstanding. In a series of long chapters he examines, with a fine sensitiveness and a wealth of erudition, many of the historical conflicts in religion, philosophy and literature, explaining them in terms of his psychological theory. This part of the book is not very simple, but makes far easier reading if the last chapter (of "Definitions") is taken first and followed by the penultimate ("A General Description of Types").

F. A. Hampton.

PREHISTORIC MAN

Ancient Man in Britain. By Donald A. Mackenzie. With Foreword by G. Elliot Smith, F.R.S. (Blackie & Son, Ltd., 12*s.* 6*d.*)

The Horniman Museum and Library, Forest Hill, S.E. From Stone to Steel : a Handwork to the Cases illustrating the Ages of Stone, Bronze, and Iron. Second edition. (S. P. King & Co., for the London County Council, 6*d.*)

In two respects Mr. Mackenzie's *Ancient Man in Britain* stands apart from the growing number of works which deal with the archæology of this country. In the first place, the author follows whole-heartedly in the footsteps of the school of Professor Elliot Smith in holding that the growth of civilisation is not due to an independent development of culture in separate areas, but is the result of a diffusion of culture from a common centre, and that this centre is Egypt. Secondly, he reconstructs the mentality of our prehistoric ancestors, as manifested in their religious beliefs, not merely by the analogies afforded by primitive peoples of to-day, but also by the analysis and comparative study of the myths, traditions, and folk-lore of the inhabitants of these islands.

It would be out of place here to discuss the arguments for and against the theory of the diffusion of culture. Without entering into an examination of the conclusions which have been put forward, it may be said that as a method it has had a profound influence on the study of European archæology along certain lines, and has at least served to broaden the outlook of archæologists. Mr. Mackenzie is, however, something of an extremist, and his readers must be prepared to adopt a critical attitude towards his conclusions. His enthusiasm is apt to outrun his sense of logic.

The scope and method of Mr. Mackenzie's book are well indicated by Professor Elliot Smith in his foreword, when he says: "The story unfolded by British finds is but part of a larger story; and if this larger story is to be reconstructed, our investigations must extend even beyond the continent of Europe"; and he also lays stress upon the principle of the unity of anthropology, which the late Dr. Rivers emphasised in his Presidential Address to the Royal Anthropological Institute shortly before his death. Mr. Mackenzie has kept both these aims in view, and his wide knowledge of primitive beliefs and customs has stood him in good stead. Among writers on British archæology it is now generally, if not universally, recognised that Britain cannot be adequately studied apart and that Europe must be taken as a whole. Less commonly, perhaps, it is realised that North Africa and Western Asia must also be taken into account. In dealing with the archæological evidence, and with the physical types of prehistoric man, Mr. Mackenzie, while keeping this principle in view, has run to the other extreme. A more systematic and detailed account of prehistoric types and culture would have been useful to the reader who has not all the details at his finger ends, and would have served as an introduction to the evidence for racial and cultural distribution and movement. This is all the more necessary, as the author himself does not appear to have digested his material thoroughly.

Many of the arguments by which Mr. Mackenzie seeks to demonstrate a connection between Britain and the Ancient East are of a highly conjectural nature, and not infrequently far-fetched. For instance, he identifies a goddess of the Hebrides with a goddess of Egypt through a shell and milk cult; but to point out an analogy is not necessarily to prove a connection.

In dealing with trade relations, Mr. Mackenzie is on surer ground, and although he ignores well-founded criticism of details of Mr. Perry's theories of the relation in distribution of megalithic (large stone) monuments and the occurrence of gold, pearls, and other objects of trade, his summary of the evidence for trading activities in Europe during the Neolithic, or late Stone, Age and the Bronze Age is one of the most useful in the book.

Mr. Mackenzie's analysis of myths and traditions is useful, and indeed valuable, as an account of primitive British belief. But, as already indicated, his conclusions on the comparative side do not convince. The treatment is confused and suffers from over-condensation. Yet the author has gathered together the material for a valuable study. Professor Elliot Smith, to quote the foreword again, says: "The physical character of a series of skulls can give no reliable information unless their exact provenance and relative age are known." The same principle applies to the study of tradition. The heterogeneous mass of material which Mr. Mackenzie gathers together, valuable as it may be as an indication of the character and mentality of primitive man in these islands, is not likely to throw much useful light upon racial questions, until it has been carefully analysed, its

origins traced, and its temporal and spatial relations disentangled.

Dr. Harrison's admirable little handbook to the collections of the Horniman Museum of the London County Council has reached its second edition some seventeen years after its first appearance. It is more than a mere description of the exhibits, and notwithstanding its modest form, it is a sound introduction to the technology and material culture of prehistoric times. It has been brought fully abreast of the numerous discoveries made since its first appearance.

E. N. FALLAIZE.

The Constitution of Matter. By MAX BORN. Translated by E. W. BLAIR and T. S. WHEELER. (Methuen & Co., 6*s.*)

A good book; a compilation by a distinguished hand, well produced and at a very reasonable price. It contains three essays, the first on "The Atom," the second entitled, "From Mechanical Ether to Electrical Matter," and the third, "The Fusion of Chemistry and Physics." These include all the most recent work on the constitution of matter, a subject on which the author is one of the foremost German authorities. The subjects are accurately but briefly explained, the illustrations are good, and the principal references to the literature form a long list at the end of each essay. All this is excellent. It is not easy to see, however, for which class of readers the book is produced. It undoubtedly supplies a want, but whose? The man who will find it most useful is he who has to give a course of lectures on the constitution of matter, for nothing could be more useful as an outline and as an inspiration, than this. But only such a one, one who already knows the subject, will get *all* the good out of it. Research workers in physical chemistry would do well to have this book upon their shelves, but I fear that the ordinary student will find it too elusive, too condensed, too specialised. There are the references, to be sure, but to most students references are just references. They have no time to delve; it is from the book itself that they must get their information.

The book, I have said, is too condensed, and the consequences of this are two. First, important matters that occupied years of research are treated in a few lines, and, second, much that is secondary, but important enough to be mentioned, appears to be of first importance. As examples of the first I may cite the work of Rutherford and of Aston. Aston's work on isotopes gets fourteen lines (but includes a good illustration); Rutherford's on the splitting off of hydrogen from nitrogen gets sixteen lines and a picture. The second brings out a point I have noticed in several books lately translated from the German: English and American workers appear to be outstarted by investigators on the Continent. In this book Moseley appears to be merely one who interposed his work between that of the Braggs and Debyes; G. N. Lewis is hardly mentioned; Sir E. Rutherford is only one of many. On the other hand, Bohr's work is rightly made very prominent, but I think there is too much about Kossel, and few would agree that "probably the best exponent of modern X-ray spectroscopy" is Siebgalin. And cryptic utterances like "[one day] all physics and all chemistry will be a branch of the theory of numbers—the theory of the atomic number z" are best omitted. If this be true, it is true only in the most sophisticated of Pickwickian senses, and only the elect understand it.

But these faults are not very serious and cannot be ascribed to the translators, who have done their work well. On page 34 they have forgotten to translate back the translated title of Rutherford's standard work on Radioactivity. And truer patriots would have put its name before, and not after, that of an Austrian book. For, indeed, if it had not been for the work of this author, first on the disintegration theory and second on the nuclear theory of the atom, there would have been little field for the very clever and distinguished men whose works have made this book.

A. S. RUSSELL.

Heat and Energy. By D. R. PYE. (Clarendon Press, Oxford, 5*s.*)

The Clarendon Science Series, a new venture of the Oxford University Press, starts appropriately with a book on Heat and Energy by a Fellow of Trinity College, Cambridge. The series has been designed as a set of readers to form the background of science teaching during the period of general education which stops for most boys and girls at the age of about sixteen. The books are not supposed to be text-books in the usual sense. It is from the latter that the large quantity of detailed facts, which examiners still insist upon, may be learned. But these books aim at concentrating upon fundamentals, in arousing the interests of pupils, in teaching the scientific point of view. A pupil, it is believed, who has become interested in the ideas of science and has been brought to appreciate scientific method is educated in a much more desirable and complete way than the "walking cyclopædia" who never thinks.

This book certainly fulfils the editor's hopes. It tries to give a comprehensive conception of Energy as the basis of all activity in Nature, and to make clear the essential unity of the different forms in which we recognise its existence; to illustrate its convertibility into forms suitable for storage, transference, and use and its final degradation to a state in which, although undiminished in quantity, it is no longer available as a source of activity. It is excellent as regards the general treatment and the information given. It is also written in a pleasant style that carries the reader on. The illustrations are well chosen, but not very well produced. Some of them are rather muzzy, a little bleached, like the appearance of a bank-note back from the laundry after having been inadvertently left in a garment. A. S. R.

Theoretical Chemistry. By PROFESSOR W. NERNST. Fifth English edition revised from the Eighth-tenth German edition by L. W. CODD, M.A. (Macmillan & Co., 28*s.*)

In a short notice scant justice can be done to a work like this one. No short *résumé* can give even the meagerest

notion of the volume's contents. It contains hardly a page that is superfluous and none that is uninteresting. The new edition is now a book of first importance. On subjects like the applications of thermodynamics to chemistry, chemical equilibrium, electromotive force, and others in which Dr. Nernst has been a pioneer, it contains the best descriptions in English. The worst one might say of it is that occasionally the author is uncritical in compiling those parts of the subjects in which he is not particularly interested. But this book is read for Nernst's own work and all of that is excellently put.

The new edition contains rewritten chapters on radioactivity and on the theory of the solid state, and many of the other sections have been revised and added to, in order to bring them abreast of the work that has been done since the last edition, published seven years ago.

A. S. R.

Colour and Methods of Colour Reproduction. By DR. L. C. MARTIN. With chapters on Colour Printing and Colour Photography by WILLIAM GAMBLE. (Blackie & Sons, Ltd., 12*s.* 6*d.*)

This important book should be read by all those who are interested in colour. It gives an accurate and well-balanced account of the whole matter, and in a form that can be understood by those who are not expert mathematicians or great students of physics. The first part of the book aims at giving a simple account of the nature of light, colour analysis, and synthesis, the colours of material objects, colour in regard to illumination, colour in human experience, and colouring materials. The second part is definitely more technical, and deals with the eye and its reactions to light, instruments for colour measurement, colour vision, and colour blindness. The third part, contributed by the editor of *The Process Year Book*, deals with colour printing and colour photography. The book is well illustrated and well produced. If all books on special subjects could be written and produced like this one there would not be much money spent on encyclopædias. A. S. R.

Ductless and Other Glands. By PROFESSOR FRED E. WYNNE, B.A.M.B., D.Ph., etc. (George Allen & Unwin, Ltd., 4*s.* 6*d.*)

A most refreshing work on a subject on which much has been written—much that is learned, much that is "popular," and very much that is sheer insanity. This book is in the best sense of the word popular. It is written in most readable style, begins at the beginning, takes nothing for granted, yet tells all that is established as regards the work of these strange and potent, yet much libelled laboratories of the human body. R. J. V. P.

Practical Bacteriology for Chemical Students. By DAVID ELLIS, Ph.D., D.Sc., F.R.S.E. (Longmans, Green & Co., 4*s.* 6*d.* net.)

This is a really admirable and thoroughly practical handbook, which will suit the requirements of that increasingly large number of students to whom a knowledge of bacteriology is important. It bears the mark of long acquaintance with the difficulties of beginners in dealing with the delicate technique and numerous pitfalls of the science. Any student who carefully follows the full and well-illustrated descriptions of the methods employed to identify bacteria will be soundly equipped for a fuller study of this wide and fascinating subject.

R. J. V. P.

Books Received

(Mention in this column does not preclude a review.)

ARCHÆOLOGY AND ANTHROPOLOGY

The Minoans. By GEORGE GLASGOW. (Jonathan Cape, 4*s.* 6*d.*)

Babylonian Problems. By LIEUT.-COLONEL W. H. LANE. With an Introduction by PROFESSOR S. LANGDON. (John Murray, 21*s.*)

The Banyankole. By JOHN ROSCOE, M.A. (Cambridge University Press, 15*s.*)

HISTORY

The Greatest Story in the World. By HORACE G. HUTCHINSON. (John Murray, 3*s.* 6*d.*)

Links in the Chain of European History. By B. M. RIFFEL. (John Murray, 3*s.* 6*d.*)

An Introductory History of England from Waterloo to 1880. By C. R. L. FLETCHER. (John Murray, 9*s.*)

MISCELLANEOUS

Dreams of an Astronomer. By CAMILLE FLAMMARION. (Fisher Unwin, 10*s.* 6*d.*)

The Works of Aristotle. Translated into English by E. W. WEBSTER. *Meteorologica.* (Oxford: Clarendon Press, 7*s.* 6*d.*)

A Fairy Tale of the Sea. By MACLEOD YEARSLEY. Illustrated by ALICE B. WOODWARD. (Watts & Co., 3*s.* 6*d.*)

Memoirs. By COLONEL SIR RONALD ROSS, K.C.B., F.R.S. (John Murray, 24*s.*)

The Pageant of Greece. Edited by R. W. LIVINGSTONE. (Oxford: Clarendon Press, 6*s.* 6*d.*)

Representative Government and a Parliament of Industry. By HERMAN FINER. (The Fabian Society and George Allen & Unwin, Ltd., 7*s.* 6*d.*)

Child Training through Occupation. By LUCY BONE and MARIE E. LANE. With an Introduction by ALICE WOODS. (Methuen & Co., Ltd., 3*s.* 6*d.*)

ENGLISH LANGUAGE AND LITERATURE

Boswell's Tour to Corsica. Edited by S. C. ROBERTS. (Cambridge University Press, 6*s.*)

Growth and Structure of the English Language. By OTTO JESPERSEN, Ph.D., Litt.D. Fourth edition, revised. (Basil Blackwell, 3*s.* 6*d.*)

PSYCHOLOGY

The Psychology of Reasoning. By EUGENIO RIGNANO. (Kegan Paul, 14*s.*)

An Outline of Psychology. By PROFESSOR WILLIAM McDOUGALL. (Methuen & Co., Ltd., 12*s.*)

SCIENCE AND MEDICINE

Textile Chemistry: An Introduction to the Chemistry of the Cotton Industry. By F. J. Cooper. (Methuen & Co., Ltd., 10s. 6d.)

Atomic Structure and Spectral Lines. By Arnold Sommerfield. Translated by Henry L. Brose. (Methuen & Co., Ltd., 32s.)

Studies in Fossil Botany. Part II. Third edition. By Dukinfield Henry Scott, M.A., LL.D., D.Sc., F.R.S., F.L.S., F.G.S., F.R.M.S. (Adam & Charles Black, 21s.)

Practical Plant Ecology. A Guide for Beginners in Field Study of Plant Communities. By A. G. Tansley, M.A., F.R.S. (George Allen & Unwin, Ltd., 7s. 6d.)

Elementary Zoology. By Oswald H. Latter. (Methuen & Co., Ltd., 12s.)

Plant and Flower Forms. By Esther J. G. Kirkwood. (Sidgwick & Jackson).

Relativity and Modern Physics. By George David Birkhoff, Ph.D. (Harvard University Press; Humphrey Milford, Oxford University Press.)

Vector Analysis. By C. Rungè. Translated by H. Levy. (Methuen & Co., Ltd., 9s.)

Foundations of Biology. By Professor Lorande Loss Woodruff. (Macmillan, 16s.)

Chance and Error. By Marsh Hopkins, B.A.Sc., M.E.I.C., D.L.S. (Kegan Paul, 7s. 6d.)

The Antiquity of Disease. By Roy L. Moodie. (University of Chicago Press, $1.50.)

Elementary Hygiene. By Bihara Lal Bihatra and Prem Nath Suri. (Longmans, Green & Co., 2s. 6d.)

Correspondence

AXIAL ROTATION

To the Editor of Discovery

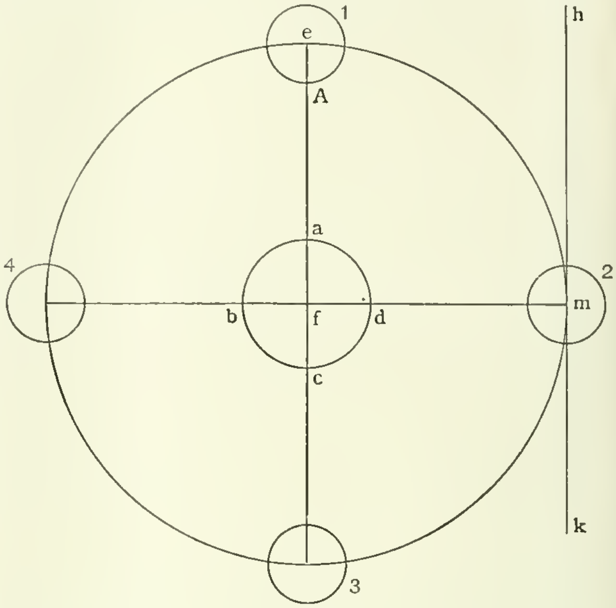
Sir,

Please be good enough to allow me space to reply to Mr. Sillem's letter in your July issue in which he is attempting to help me in my perplexity concerning the moon's movements. I regret to inform him that I am not yet "out of the wood." I was staggered when he told me that the disk on the second's hand of my watch, the ball on the string, the orange near the circumference of the turntable, were each turning upon their own axes.

He has not, however, said anything about the spinning-top or the bicycle pedal.

In his diagram (which perhaps you will be good enough to reproduce here) he represents the moon in the position it would occupy if *not rotating.*

It will be noticed, however, that this is an exact representation of the pedal action, viz. forward revolution and backward rotation, both movements synchronising. This, I think, is where the *theory* of rotation breaks down, because lines in the pedal (picture it as a ball) do not change their direction. But if the pedal makes the merest fraction more, or the merest fraction less, than one rotation each revolution then lines would change their direction. So you see the rotation does not count, but 1·0001 does. In the diagram at 1A we will suppose is the crater "Flammarion," 235,000 miles from the earth's surface. The moon is 2,000 miles in diameter, so that the



crater at 3A is 237,000 miles from the earth's surface. It has travelled in a semicircle from 1,000 miles inside the moon's orbit (a thin line 236,000 miles from the earth) to a 1,000 miles outside around what? Surely the moon's axis. London does this trick daily, and we call it axial rotation. If it ceased to do it, what then?

I am, sir, yours, etc.,
J. Marshall.

2, Heath Villa,
Birchwood Drive,
Leigh-on-Sea.
July 7, 1923.

[This correspondence must cease.—Ed.]

SUSPENDED ANIMATION

To the Editor of Discovery

Dear Sir,

In connection with the alleged finding of frogs embedded in the ground, which is the subject of a letter in the August number of Discovery, the following extract may be of interest:

"At his advice, we sank the well, and at a depth of 14 feet came on water in marly rock. . . . One of the curious things in sinking the well was, at a depth of 12 feet we came across several green frogs in the marl, and as soon as they were exposed to the air they turned black and died."

The letter, from which the above is taken, was addressed by Mr. Codrington Crawshay, J.P., of Abergavenny, to Professor (now Sir William) Barrett, on May 25, 1897. It may be found in the *Proceedings of the Society for Psychical Research* (Part 32, vol. xiii, July 1897, p. 151).

Yours, etc.,
Brian J. McCaffery.

College of Science,
Dublin,
August 1, 1923.

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Editorial Notes

AN account of the principal addresses at the British Association's Meeting at Liverpool in September appears in this number. This account will, we hope, show the very definite work which scientists are doing in the solution of the thousand and one problems of our modern complex civilisation. It is evident to us that a marked change of feeling has come over the public in their attitude towards scientists during the last year or so. They are beginning to be listened to more seriously and the jokes about them in the press are rapidly vanishing! People are realising that the word "scientist" is not synonymous with an old, hairy, bespectacled professor surrounded by books and bones or fumbling about with evil-smelling liquid concoctions. There is less opposition, too, than there was in Darwin's day between science and religion, and we have recently seen in the press the Dean of St. Paul's patting Mr. Julian Huxley, the well-known young Oxford biologist, on the back for an essay of his on "Science and Religion," albeit be made some errors in interpreting parts of this essay!

* * * * *

Moreover, many of our modern scientists are adventurers not only in theories or in laboratory work, but in foreign lands and the few remaining unknown regions of the earth, and their deeds in such a rôle cannot fail to appeal to the British psychology. In this number of DISCOVERY Mr. R. W. James writes on the subject of pack-ice, recording carefully and unostentatiously his examinations of the vast ice-floes and their movements in the Antarctic made when he was a member of the *Endurance* expedition. His narrative is purely scientific and, therefore, we cannot publish it without filling up some of the gaps of adventure and peril. The expedition of the *Endurance* commanded by the late Sir Ernest Shackleton performed some of the most astounding feats recorded in the annals of polar exploration. At the time these feats were eclipsed by the world-war, and despite Shackleton's account [1] and the cinematograph records shown subsequently, they are perhaps still sufficiently unknown to merit being described here. After voyaging south from South Georgia, the *Endurance* was beset in the ice on January 18, 1915. The members of the expedition remained on the vessel, which drifted northwards in the vast drifting ice-floes till she was crushed on October 27. They then took to the ice with their tents, boats, and stores, watching their refuge of many months disintegrating till she sank on November 21. Till January 2, 1916, they drifted northwards for 350 miles on an ice-floe, which with the increasing warmth broke up into countless fragments till one night they found themselves on a piece of flat ice 200 ft. long and 100 ft. wide. At last there was sufficient room between the bergs to take to the three boats, which were launched on April 9, 1916, and reached Elephant Island six days later, after some narrow "shaves" with onrushing ice débris.

* * * * *

This was the first landing ever effected on the island. Shackleton set off in his famous open-boat journey to South Georgia to obtain relief, while twenty-two members of the expedition, including Mr. R. W. James, were left on the island under Commander Wild. There they lived for nearly five months under precarious conditions, sleeping under the two remaining upturned boats and eating seal, penguin meat, limpets, and seaweed till, after various unsuccessful attempts,

[1] *South*, by Sir Ernest Shackleton. (Heinemann.)

Shackleton, in the *Yelcho*, a steel vessel belonging to the Chilian Government, rescued them on August 30, 1916. They were down to their last Bovril ration and had scarcely four days' food in hand; ice-floes were rapidly closing in on the island, and in another few days it might have been necessary, with almost undoubtedly disastrous results, to have postponed the work of rescue till the next year.

* * * * *

Archæological work in the Mediterranean and the Near East is being attended with remarkable results. The finding of Tutankhamon's tomb in Egypt last autumn has been followed this year by the successful excavation of the ancient Chaldean temple of the Moon-god in the sand-covered mounds in Mesopotamia, which mark the site where five thousand years ago flourished the great city of Ur, and by some extremely interesting discoveries made by Sir Arthur Evans at Knossos, in Crete. The recent excavations at Ur are described by Messrs. Hall and Woolley, whose efforts have been largely responsible for their success, in this number of Discovery. Sir Arthur Evans has described the results of his excavations in Crete in articles in *The Times* of August 28 and 29.

* * * * *

Our readers may remember that we reviewed last month an excellent little book on the results of Sir Arthur Evans's and other archæologists' excavations in Crete, and emphasised the fact that our knowledge of the commercial and cultural relations between Egypt and Crete were still very scanty. Crete, we have to bear in mind, was the stepping-stone in the Mediterranean for the ancient Egyptian civilisation that penetrated into Europe through Greece. Any new evidence, therefore, that can be obtained of the relations between Egypt and Crete goes to the reconstruction of a most important page in the history of early civilisation. Sir Arthur Evans's researches in Crete this year have provided a goodly number of bricks for such a reconstruction.

* * * * *

In the first place, he has succeeded in tracing a prehistoric road across the island from Knossos on the north coast to Phaestos on the south coast—a road which he believes formed part of the route used to link Knossos with the Libyan coasts, the remainder of the route being, of course, maritime. Another piece of evidence of trade between Egypt and Crete was revealed in the discovery of an early dynastic porphyry bowl. More remarkable still was the finding of a house of frescoes at Knossos which, in Sir Arthur's words, constituted "a unique illustration of the painter's art as it existed in the Golden Age of Minoan Crete." These frescoes are of an age not later than 1,600 B.C. The scenes in these mural decorations, he says, "are laid amidst rocks with flowering plants or sometimes marine growths; the rocks being vividly veined and banded so as to resemble cut sections of such stones as agate, sardonyx, or malachite. Their outlines show an extraordinary feeling for the 'grotesque' in art, and their borders were at times flung by the artist across the carefully executed and many-banded frames, as if the artist gloried in the defiance of artificial control. . . .

"Besides olive sprays, there are seen impressionist designs of branches bearing what look like egg-shaped plums, red and yellow."

* * * * *

Part of the frescoes show monkeys fairly easily identifiable as of the *Cercopithecus* variety, which were possibly imported by the Minoan priest-kings from the Sudan or were received by them as gifts from the Pharaohs of Egypt. Some small fragments of painted stucco frieze show a picture of a Minoan captain, with his men, whose skin is coal-black. "So the historic secret is out," writes Sir Arthur. "Minos employed negro mercenaries."

* * * * *

One is tempted to ask whether there is any common cause for the widely separated disasters due to disturbances beneath the earth during the last twelve months. First there came the great tidal wave on the west coast of South America, destroying several seaboard towns; this was followed early this year by earthquakes in Kamchatka, later by the eruption of Etna, the most severe for many years, by volcanic disturbances in the China Sea, and finally the Japanese earthquake, which we believe is the most disastrous in recorded history. There is not yet any agreement as to the cause of earthquakes, in fact it is probable that several causes may be operative on different occasions. Humboldt, the great scientist and traveller, wrote nearly a century ago that in South America there was a constant relationship between earthquake and volcano; he thought that volcanoes were a safety-valve, and noticed that when in a volcanic country eruptions grew less frequent, earthquakes were to be feared. This opinion is at least as old as the ancient Greek and Roman writers, and the researches of Professor John Milne in 1895 showed that in Central Japan, where volcanoes are many, earthquakes are rare, and that by the sea-coast, especially in the east, the reverse is the case. Sometimes great volcanic eruptions and devastating earthquakes occur in close connection; this was the case in Hawaii in 1868. In other cases, however, volcanic eruptions of exceptional severity have taken place without any earthquake, perhaps because the "safety-valve" action has been efficient. It is probable that in many cases where no activity has been

noticed, earthquakes may yet have been caused by eruptions of molten lava which have not reached the surface, since geological evidence shows that these subterranean intrusions do take place.

* * * * *

The theory that earthquakes are due to the tidal attraction of the moon has been recently revived in several quarters. It is a very old idea, and superficially sounds attractive, especially if the view, now discredited, that the earth consists of a solid crust and a molten centre, is held. It was put on some kind of basis by Alexis Pewey in 1864; he collected a very large number of records of earthquakes, and found that they were more numerous when the moon was nearest to the earth. Since his day, however, a great many more records have been made, and it is certain that there is no relationship between the nearness of the moon and disasters such as that in Tokyo. However, the statistical work done by Pewey has proved invaluable to later workers.

* * * * *

In a general sense, it is certain that an earthquake is an effort on the part of the surface of the earth to accommodate itself to a stress or strain. Dr. Robert Mullet thought that this strain was caused by the gradual cooling of a heated globe; every now and then the earth cracks like a glass vessel, in his view, since the hard outer crust must accommodate itself to the shrinking core. Other authorities have considered the effect of long ages of redistribution of loads caused by the denudation of mountains by ice and rain, and the consequent instability. Perhaps most earthquakes may be attributed to a cause of this nature. The balance of the earth's surface, which has been upset by ages of denudation and sedimentation, is suddenly restored by what is called a "Tectonic earthquake." Sometimes a deep shelf is caused by the sudden collapse; sometimes the disturbance is beneath the sea. Why earthquakes are more common in one part of the world than another; why volcanoes appear to have a definite relationship in many cases, remain difficult questions to answer. They are perhaps bound up with the problem of the formation of the earth's surface discussed in recent articles in this Journal.[1]

* * * * *

Articles in our November number will include: *An Imperial Airship Service*, by Major W. T. Blake; *A Working Philosophy of Life*, by Dr. W. Tudor Jones; *The Berber Tribes of Morocco*, by Dr. E. Gurney Salter; and *Arsenic Burning in Devon and Cornwall*, by Edward Cohen.

[1] See DISCOVERY, vol. iii, No. 29: *The Origin of Continents and Oceans*, by Professor Alfred Wegener; vol. iv, No. 43: *The Structure of the Earth—A New Theory*, by O. H. T. Rishbeth (describing Kober's theory).

The Shrine of the Moon-god, and other Recent Discoveries at Ur

By H. R. Hall, D.Litt., and C. L. Woolley, M.A.

THE mounds of Tell el-Mukayyar, near Nasirîyeh in Southern 'Irak, which we now know to mark the site of the ancient Ur of the Chaldees, have been noted as a seat of early civilisation ever since the time of the Italian traveller Pietro della Valle, who in 1625 first described the temple-tower which then as now dominated the surrounding mounds like an Egyptian pyramid. Della Valle brought back to Europe some of the inscribed bricks that then as now strewed the site, and was the first to conjecture that the strange marks upon them were ancient writing.

Early Excavations on the Site

The interest of the British Museum in Tell el-Mukayyar dates from the time when Rawlinson at Baghdad was deciphering the cuneiform script and British influence was powerful in Turkish Asia, so that requests from British travellers and antiquarians to excavate and seek for antiquities met with ready acquiescence. Moved by Rawlinson and the accounts of Mr. Loftus, of the Persian-Turkish boundary commission of 1849, who had excavated at Warka and Susa and visited Mukayyar, the Trustees of the British Museum in 1854 deputed Mr. J. E. Taylor, H.M. Vice-Consul at Basrah, to excavate at Mukayyar and at the neighbouring mounds of Shahrein, which cover the ancient city of Eridu. He dug with considerable success at both places and gave us the first intelligible accounts of them, besides sending back interesting antiquities (such as the foundation-cylinders of Nabonidus's restoration of the temple-tower at Ur) which have been in the British Museum since the time of the Crimean War.

Post-war Excavations

The work then lapsed, and was not resumed till the last year of the Great War, when the Trustees determined to take advantage of the British military occupation of 'Irak, and resume archæological operations there. Captain R. Campbell Thompson, late of the British Museum and then on the Intelligence Staff of the Army in Mesopotamia, was commissioned by the Museum authorities to take up this work, and proceeded to Ur and Shahrein in 1918. At Ur he made a short preliminary investigation, then confining his work to Shahrein. Next year (1919) Mr. (then Captain) H. R. Hall, of the British Museum, was sent

out to carry on the work, Captain Thompson having returned home on leave. Mr. Hall also worked at Shahrein, but devoted most of his attention to Ur and a subsidiary mound, about four miles off, known by the names of Tell el-Ma'abed (" Mound of the Place of Worship "), Tell el-'Abd (" Mound of the Slave "), or Tell el-'Obeid ; the last name is that most generally used. It was at Tell el-'Obeid that the chief discovery of the expedition of 1919 was made, in the shape of a small L-shaped building of very early " plano-convex " bricks, apart from which, at the south end, was found a cache of copper figures of the early knowledge of ancient Sumerian[1] art and to the collection of the British Museum.

At El-'Obeid, as at Shahrein, much was gleaned from the surface of the desert that is undoubtedly of pre-Sumerian age, consisting of stone objects of various kinds, including flakes and celts of obsidian crystal and chert that are considered to belong to the latest Stone Age or the Chalcolithic period, and fragments of the characteristic prehistoric Babylonian pottery, made before the invention of the quick wheel, and decorated not only with geometrical but also with frankly naturalistic designs (not so stylised as at Susa) in

FIG. 1.—GENERAL VIEW OF *Ê-NUN-MAKH*, UR : 1923.
By courtesy of the British Museum.

Sumerian period (about 3000 B.C.) : lions and small bulls of copper with bitumen within (like the figure of Bel in the Book of Daniel, that was " brass without and clay within "), a copper relief, 8 ft. long, of a lion-headed eagle (the emblem of the city of Lagash) grasping two stags by their tails, a gold bull's-horn, a stone figure (torso) with a very archaic inscription commemorating a certain Kur-lil, keeper of the granary of the city of Erech, a squatting stone figure (complete), probably of the same person and certainly of the same period (Fig. 3) ; besides various other antiquities, such as pottery, flower-decoration for walls with stone petals fastened by copper wire ; all of the same period, and forming an important addition to our black and occasionally in red. This pottery is identical with that found by Pézard at Bushire recently, and is related to that discovered by de Morgan at Susa and Tepe Musyan in Persia and that found by Herzfeld at Samarra in 'Irak. It has been described and illustrated by Thompson in his publication of the work of 1918 at Shahrein in *Archæologia*, vol. lxx, 1920, and by Hall in the *Journal of Egyptian Archæology*, vol. viii, 1922. It is found also at Ur here and there. This style of pottery-decoration of the primitive period is found in Turkestan, at Anau

[1] The Sumerian civilisation in Mesopotamia is a less known but even earlier civilisation than that of the ancient Egyptians.

to the west and in Baluchistan to the east, and even so far east as Honan in China. It may be related also to the early pottery of the Black Sea region and Thessaly. In Babylonia it would appear to have been abandoned in the Sumerian period for a plain drab ware that persisted till the end.

A Vast Sacred Enclosure

At Ur one of the chief discoveries of 1919 was that of the wall of the sacred enclosure and temenos of the Moon-god, which was identified as such in 1919. The upper part of this wall was then uncovered for a stretch on the east side of the temple tower, at each end of which a great gate was discovered by the explorers of 1923, Messrs. C. L. Woolley, F. G. Newton, and Sidney Smith (of the British Museum). This renewed work of the British Museum was shared in, under the direction of Mr. Woolley, by the University of Pennsylvania (Philadelphia Museum).

In the 1922-3 season, the main work was the tracing of the outlines of the sacred enclosure. This was found to be a rectangle some four hundred yards long by two hundred wide, surrounded by a heavy wall built of unbaked brick which enclosed intramural chambers; its outer and inner walls were each more than three yards thick, the chambers over four yards across, so that the total width of the whole wall was some thirty feet; its exposed faces were decorated with buttresses and with vertical T-shaped grooves in the brickwork. There were apparently six gates (of which only four have been excavated); as a rule, the gateway lay in the centre of a fairly deep recess set back from the wall line; strong towers flanked the entry, which passed through a gate-chamber formed by the two pairs of boldly projecting buttress-jambs and was closed by a wooden door set between the outer jambs; the gate-chamber was roofed with heavy palm-logs overlaid with matting and earth as are the modern houses of the country.

There must have been a sacred enclosure at Ur from the earliest times, but a large number of inscribed clay cones found along the wall line inform us that the wall was built by Ur-Nammu or Ur-Engur, the first king of the Third Dynasty (*c.* 2300 B.C.), who probably enlarged at the same time as he refortified the old enclosure. How much of the surviving work is to be attributed to Ur-Nammu it is hard to say; the wall was patched and even rebuilt by his successors down to the last days of the city, and as all of them employed mud brick, and built in the same style and more or less on the same lines, there is little to distinguish the early brickwork from the later; most of the gates, where the use of inscribed burnt bricks and of inscribed stones as hinges for the doors affords dating evidence, have been entirely rebuilt, and the names encountered in them are those of Nebuchadrezzar, Nabonidus, and Cyrus the Great (559–529 B.C.), so that they date from the last century of the town's existence.

Within this enclosure lay the chief temples of Ur. Towards the eastern corner rose the huge ziggurat,

FIG. 2.—EXCAVATING THE TEMPLE OF THE MOON-GOD AT UR IN 1919.
The *ziggurat*, or temple-tower, in background.
By courtesy of the British Museum.

the staged tower already mentioned above which was the outstanding feature of all Sumerian towns, its bulk dwarfing all the other buildings of the place and dominating the flat alluvial plain around; even today its ruins are a landmark visible for many miles. In the south corner there may have been the palace of the king, a site which perhaps still awaits excavation; the rest of the temenos, so far as we can yet judge, was occupied by temples.

Temples and Palaces

In 1919 Mr. Hall discovered and excavated partially to the south-east of the tower a brick building (pro-

visionally known as "B") which at first was supposed, on the evidence of the stamps on bricks of its pavement, to be É-ḫarsag, "House of the Mountain," a palace of the King Shulgi or Dungi, the successor of Ur-Nammu. This evidence is apparently contradicted by the discovery in 1923 and identification by

FIG. 3.—SMALL STATUE OF KUR-LIL, DOORKEEPER OF THE TEMPLE OF ERECH; ABOUT 3000 B.C.
Found at el-'Obeid, 1919.
By courtesy of the British Museum.

Mr. Sidney Smith of a brick with the temple-inscription of Ur-Nammu in the wall of the building. It is not yet decided, therefore, whether this building is a palace or a temple, though Mr. F. G. Newton, speaking as an architect, pronounces in favour of a temple and the authority of Ur-Nammu's bricks over Shulgi's! Unluckily a foundation-deposit excavated in 1923 yielded us no decisive evidence on the point, as the tablet accompanying it, which should have told us the name of the builder, was blank.

This building "B," if a temple, was no doubt part of the great temple of Nannar. The part uncovered (Fig. 2) may have been chiefly the priestly quarters. It was later on, after it had long been burnt and ruined, reoccupied and then certainly inhabited (in the Assyrian period probably) by priestly families who rebuilt it on a slighter and smaller scale, generally using the ancient bricks for the purpose. Some of their domestic additions, such as bread-ovens, wash-places, etc., still remain, and the later walls, either of their time or (some) possibly of even later period, are easily distinguished by their slightness and careless building from those of the original builders, which are splendidly built and generally 5 ft. thick. In this building pottery and tablets of the Assyrian period were found in 1919, and a few relics of the original builders, including two fragments of statues (now in the British Museum) of the later Sumerian period, the age of Gudea, whose famous statues are now in the Louvre.

If "B" is part of the temple, then the palace Ê-ḫarsag is to be sought elsewhere, possibly near-by, as has been suggested above. In 1919 a foundation tablet of Ur-Nammu was found loose in rubbish against the south wall of "B," which commemorates the founding of *Ê-makh*, "the Noble House," a temple of the goddess Ninsun. It is not impossible that "B" may eventually turn out to be Ê-makh.

In 1919, and also in 1923, several graves were discovered and excavated. The work of 1919 was purposely directed to the discovery and investigation of as many different types of ancient remains, whether temples or tombs or what not, as possible, in order to obtain an idea of what the site was likely to yield in the future. It was intended to "sample" the site. For this reason a beginning was made with the excavation of the town ruins to the south of the transverse *wady* (small valley), south of the sacred enclosure, which divides the mounds of Ur into two parts. Among the few ruined streets and houses which were investigated were found many pottery coffers or *larnakes* with burials, always of bodies in the crouched position, with a few pots, beads of agate and cornelian and amethyst, and perhaps a silver pin or two. They are of comparatively late date, probably of the Assyrian period. Actual tombs of bricks, built up with a keeled roof over the larnax, were also discovered in another part of the mound, near the ziggurat. Another type of burial was in two large round pots, placed mouth to mouth, with vent-holes at the other ends to enable the gases to escape.

The Shrine of the Moon-god

In the course of last season Mr. Woolley and his associates completely excavated a second temple (Fig. 2), *Ê-nun-makh* or *Ga-nun-makh*, which was dedicated to the Moon-god and his consort. The building stood upon a low platform supported by a brick retaining wall, 9 ft. thick and heavily buttressed. The sanctuary proper was quite small, consisting of five rooms connecting with each other, and was entered by a single rather narrow door. Round the sanctuary ran a corridor, and between this and the platform wall

all the space was occupied by a series of long-service chambers which were used either as store-rooms or for other purposes connected with the temple. Several times in the course of its history È-nun-makh had been destroyed, and as often rebuilt from the ground up, and still more often had kings and rulers of Ur patched and repaired the venerable shrine: but all had been careful to adhere to its original ground-plan, using what remained of the old walls as foundations for what had to be built afresh; one or other might make some addition to the temple, increasing its area, but none ventured to alter the type which his predecessors had laid down once and for all. The first royal builder whose name is recorded on the bricks is Ur-Nammu, but the temple had been razed and rebuilt at least three times before he came to the throne in about 2300 B.C.; we have objects dedicated in it by Rimush, who was king of Agade about 2650 B.C., but that date would hardly take us back through more than one period of reconstruction; the walls of *terre pisée* (stamped-down earth) which we found underlying the earliest mud-brick structure may well belong to the fourth millennium before Christ. The Third Dynasty was brought to an inglorious end by an Elamite invasion, when the temple of the Moon-god must have suffered severely; certainly it had to be repaired fairly extensively by the kings of the Larsa Dynasty who in their turn controlled Ur, for we find cones and bricks of Nur-Adad, Arad-Sin, and Rim-Sin. A thoroughgoing reconstruction was undertaken by King Kudur-Mabug, about 2000 B.C., and there are few parts of the existing building where his work cannot be traced.

But the reconstructed building was not destined to endure for very long. Early in the second millennium a fresh disaster overwhelmed the city, and the Moon-god's shrine was destroyed; beneath the pavement of the succeeding period was found a thick stratum composed of the fragments of stone vases, dedicated in the temple by royal worshippers ranging from Rimush to Rim-Sin, which had been wantonly smashed and thrown away—an act of sacrilege which can only have been ventured on by an alien conqueror. Kurigalzu, who reigned about 1600 B.C., was obliged to rebuild È-nun-makh from its foundations. His temple, subject to minor repairs, e.g. by Sin-balatsu-ikbi, Chaldean governor of Ur under the Assyrian overlord Ashur-bani-pal (669-626 B.C.), lasted for a thousand years; then, about 600 B.C., Nebuchadrezzar not only rebuilt but remodelled it. The King of Babylon respected the ancient sanctuary, but he swept away all the service-chambers that lay in front of its door, and substituted for them two paved courts—a lower and larger court extending across almost the whole width of the original platform, an upper court opening off it and surrounded on three sides by the sanctuary façade and by two new wings that were now built up against the same. Thus the whole character of the place was changed; whereas the sanctuary had been shut away in the midst of its outbuildings, approached only by a winding passage (a sanctuary, it is evident, reserved for a priesthood practising a secret ritual); it now formed the background of an open court where the public could assemble and watch the sacrifice being performed on the upper terrace, and see, beyond the officiating priest, the golden statue of the god inside the shrine, set on the base of which, and immediately fronting the door, the foundations still exist. There had been a change from private to public worship such as is hinted at in the story of Nebuchadrezzar and the Three Children in the Book of Daniel. The same arrangement of the temple was observed when Cyrus

FIG. 4.—HEADLESS STATUE OF ENTEMENA; ABOUT 3000 B.C. Found at Ur, 1923.
By courtesy of the British Museum.

the Great in his turn repaired Ê-nun-makh, and it is interesting to see how closely that agrees with the description given by Herodotus of the contemporary temple of Bel at Babylon.

Of particular interest are the broken fragments of dedicated vases which have already been mentioned, for these not only, by their decoration and by the inscriptions on them, throw light on the early art and history of southern Mesopotamia, but they have an important bearing on the vexed question of Egyptian chronology. The whole collection belongs to a period whose limits are 3000 to 2000 B.C., and many of the vases are of Egyptian type and material, in some cases apparently actual importations from the Nile valley, in others close copies of imported originals ; and while the bulk of the types are those of the First Egyptian Dynasty, none are later than the Fifth. So far as it goes, the evidence is all in favour of the "shorter chronology" ; it is to be hoped that further synchronisations may yet be found to settle this much-disputed problem of ancient history.

A Royal Statue 5,000 Years Old

Our most important individual "find" was a headless diorite statue of Entemena, king of Lagash about 2900 B.C. (Fig. 4). The squat figure wears the usual Sumerian robe of sheep's fleece, and bears a long inscription engraved across the back and shoulders. In a deep brick-lined well there were found a number of large clay cones inscribed with the building records of the Larsa kings who reigned towards the end of the second millennium, records which add greatly to our knowledge of the history of the site. Under the Persian floor of Ê-nun-makh was discovered a hoard of jewellery, beads, brooches, pendants, earrings, bracelets, and rings of gold and semi-precious stones, a gold pin with a head in the form of a full-length figure of a priestess, and bronze and silver vessels, all heaped together below the pavement-tiles. A smaller hoard found in another part of the site was of earlier date, probably of the seventh century B.C.

The great temples of the sacred city were repaired for the last time by Cyrus. Not long afterwards, perhaps about 450 B.C., Persian iconoclasts, who made a movement against the use of images in religion, destroyed by fire all these monuments of old idolatry. Ur did not long survive the religion which had been its glory ; a rapidly dwindling remnant of inhabitants squatted on the ruins of the ancient shrines, and probably by the time of the Macedonian conquest the city (333–323 B.C.) was "fallen upon an heap," hardly less desolate than it is to-day.

At present we have recovered only the skeleton of a history which lasted for at least four thousand years, perhaps for twice as long ; further excavations should fill up many gaps in our knowledge and yield something like a continuous record of this, one of the earliest cradles of Man's civilisation. It is to be hoped that the happy co-operation of the British Museum with the Museum of the University of Pennsylvania, inaugurated by the renewed work of 1922–3, will result in the construction of such a record obtained from regularly continued and systematic excavation.

Antarctic Pack-ice and the Fate of the "Endurance"

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SURROUNDING the Antarctic Continent, and extending in many regions hundreds of miles from its shores, is a great belt of floating ice, known usually as the pack-ice, or, more shortly, simply as the "pack." This ice-belt is certainly one of the most considerable of world-phenomena. Formed mainly in high southern latitudes by the freezing of the sea-water, the ice is driven northward by the prevailing winds which flow outwards from the continental ice-cap, while to the south fresh ice is formed to take its place, so that there is, on the whole, a continuous flow of ice northward, carrying polar conditions considerably beyond the true geographical polar regions.

The study of the movements of the polar ice is of great scientific interest, particularly from the meteorological point of view. It is perhaps not too much to hope that, as the circulation of air and ice in the polar regions becomes better known, weather forecasting in the Southern Hemisphere may become much more definite than it is at present. Weather is largely conditioned by air movement, and air movement is due in the first place to temperature differences. Evidently then, a northward flow of ice and cold air from the polar regions on such a vast scale must have enormous influence on the climatic conditions of the whole hemisphere.

Hitherto the pack-ice has been considered mainly as an obstacle to navigation. Such detailed studies as have been made of it have been made by ships frozen in and forced to drift with the ice. Such drifts are irksome and dangerous, and fatal to the full success of an expedition, yet they are not without scientific value. In the Antarctic the drift of the pack-ice has been studied in this way by the *Belgica*,

to the west of Graham Land; by the *Deutschland*, in the Weddell Sea; by the *Endurance* of Sir Ernest Shackleton's 1914 expedition, also in the Weddell Sea, but on a course considerably to the west of that of the *Deutschland*; and by the *Aurora* of the same expedition in the Ross Sea. The ice circulation is thus best known in the Weddell Sea, a great bight extending to nearly 78° south latitude, south of the Atlantic.

James Weddell, who discovered this sea, reached a latitude of 74° 15′ S. in February 1823 with no ice in sight, but otherwise the reputation of the sea for ice is bad. Bruce, who discovered land on the eastern side of the sea in 1904, which he called Coats Land, was prevented by ice from reaching a high southern latitude, and attempts by Larsen and Nordenskjöld to penetrate very far south on the western, or Graham Land, side of the sea were much hampered by heavy pack. In fact, in the south-west part of the sea, land has not yet been sighted. The German expedition under Filchner attained a latitude of 77° 40′ and actually made a landing, but finding no suitable place for winter-quarters, made their way north again, and were caught by the ice in March 1913, and after a drift of eight months, were released in lat. 63° S.

How the "Endurance" was Frozen in

The *Endurance* left South Georgia in December 1914, the intention being to form a base near the land discovered by Filchner. Ice was encountered near the South Sandwich Islands, about lat. 58° S., and the course was set to the east to try to get round the ice, but as it seemed to extend indefinitely in that direction, the ship's head was turned south a few days later. For the next month the ship was forced through the pack, which most of the time was fairly close, and on January 10, 1915, Coats Land was sighted. The ice was thick and heavy off the land, but there was open water along the coast and good progress was made along new land until January 18, when the junction with Filchner's Luitpold Land was nearly reached. Here misfortune befel the *Endurance*. She had to put out some thirty or forty miles from the land in order to get round some heavy pack, and in trying to force a way through a thick belt of ice she was held up, and was unable to move either backwards or forwards. All might yet have been well had not a persistent north-easterly wind set in, which carried down quantities of drift-ice which lay to the north, and packed it closely round the ship. The

FIG. 1.—THE *ENDURANCE* SET IN THE ICE.
By courtesy of William Heinemann.

temperature fell very low for the time of year, and by the end of February it was plain that the *Endurance* was frozen in for the winter. The ice and its movements and changes now became a most important and interesting matter, since the fate of the party largely depended on what the ice might do, or where it might be taken. Starting with the freezing-in of the ship, let us follow the life-history of the pack as it was observed by the *Endurance* party.

We must consider first of all not an ice-free sea, but one covered with more or less closely packed drift-ice, one, two, or even more years old, much of it very heavy. This ice was often several feet in thickness, deeply snow-covered and ridged up into hummocks. It had been formed, in all probability, at a great distance from its position at that time. In the summer it is not as a rule cold enough to cause any permanent freezing of the water between the heavy floes; they remain separate, and may be likened to the pieces of a gigantic jig-saw puzzle spread over the surface of the sea. The loose floes do, however, tend to keep together in fairly closely packed belts or streams.

Into such a belt the *Endurance* forced her way and was finally held up. Before a change of wind loosened the ice enough to free her again, the next stage in the formation of the winter pack had started; the water between the floes began to freeze, cementing the loose aggregates of smaller floes into much larger ones, many square miles in area. In the middle of such a floe the *Endurance* was now firmly frozen. Attempts had been made to break her loose, and partly as a result of these, partly owing to ice movement, a large pool had been formed in which the ship lay. This was fortunate, as when the pool froze the ship was held in a strong sheet of fairly homogeneous ice. During the winter the ice on this pool reached a thickness of about 5 ft. Very soon the wind drifted the snow over the surface of the floes, and the joins between the older floes were mostly hidden, so that the composite nature of the larger ice-floes could easily be forgotten.

The ridges and hummocks on the surface of the ice act as sails, and the floes drift before the wind. Very large areas are set in motion at once, floes and icebergs move at the same speed, so that the movement can only be detected by astronomical observations. Every day, therefore, when possible, the ship's position was determined. The drift was at first to the west, but in March became more northerly, and it was evident that the ship was in the main circulation of the Weddell Sea ice, and likely at all events to solve certain problems of interest, even although the expedition had failed in its main object. The ice-fields, although very large, do not cover the whole sea in the same way that ice covers a pond, otherwise such movements as those described above would be impossible.

The large floes are, in fact, continually breaking up and joining again, steady motion over a large area seldom being maintained for very long. There are several reasons for this. The original ice-floes from which the aggregates are formed float in equilibrium on the water, which supports them in the most effective way. If a number of such floes are cemented together by new ice, the resulting large floe will still rest in equilibrium; but if, later, the wind drifts the snow about the surface, altering the distribution of weight, equilibrium will no longer be maintained, and considerable tensions may be set up in the ice, which may be large enough to cause it to break. Strains may be set up in a different way. If the ice-field is large, the action of the wind on different parts of it may vary greatly both in force and direction, and once again tensions may be caused with the consequent formation of cracks.

Ice "Ridges" Separating the Floes

For various reasons then, the ice-field is likely to crack. The cracks form very suddenly and may extend for miles; they may remain fairly narrow, or they may open out into large "leads" a mile or more wide. In the winter these newly formed leads freeze over very quickly. In the course of a few days a foot or more of ice will form, and if, in the meantime, there has been no relative movement of the floes, the new ice will be level, although never slippery, and its surface will present a very marked contrast to the older snow-covered floes on either side of it.

Suppose now that relative movement of the ice begins again, owing to a disturbance of the temporary equilibrium, by wind or current, so that the two heavy old floes move together again. The foot-thick ice on the lead will be unable to resist this movement, and will crumple and break, and pile itself up into ridges formed of ice-blocks of all sizes, up to a few feet square, until the old floes are nearly together again. Thus the lead or crack is replaced by a pressure-ridge. This process is always going on and the landscape is always changing. Every large floe is surrounded and separated from its neighbours by a "hedge" of pressure-ridges, and the ice-surface becomes more and more irregular and difficult to march over. The ridges extend of course, to a much greater depth below the water than they do above it. The ice along such a ridge may, perhaps, be 100 ft. thick, although the general thickness of the floe which it borders may be only a few feet. A pressure-ridge is usually a line of weakness. In spite of its immense thickness, the actual contacts of ice-block against ice-block form

only a small fraction of the total surface of separation, and breaking constantly occurs along old pressure-ridges.

The heaviest pressure-ridges are formed by a somewhat different process. Suppose a crack has divided a heavy floe into two pieces, each perhaps several miles square, and that they then move together again. They will rarely come together so that they fit exactly, for there will nearly always be some lateral displacement. Most of the pressure between the two will be taken on a few projecting corners. In addition there may also be a twisting or screwing motion of the ice. If the pressure goes on, a buckling of the floes at the regions of contact will occur. Blocks from one floe will be driven up over the surface of the other, and in this way ridges are formed of blocks perhaps 5 or 6 ft. thick. This process is known as "rafting." Pressure-ridges seldom reach a great height. Thirty feet was very exceptional in the Weddell Sea, and from 10 to 15 ft. above the water-line may perhaps be taken as an average height. The formation of pressure-ridges by screwing and rafting is the greatest danger to which a ship drifting in the pack-ice is exposed. This type of pressure, during the drift of the *Endurance*, became more common towards the end of the winter. It did not as a rule occur during gales, but generally in periods of calm, often shortly before a gale. We may perhaps get an idea of its causes from the following analogy.

Wind Effects on Drifting Pack-ice

Suppose a jig-saw puzzle, emptied out on a smooth table, is pushed along by means of a ruler. This may be taken as representing pack-ice drifting under the influence of a wind. The analogy is not quite accurate, since the wind, when conditions are steady, will act all over the surface of the ice, and not just along the edge of the field ; but if we suppose all the pieces of the puzzle to be moving steadily to begin with, this will not matter. Now suppose we move the ruler and apply it in a different direction. This represents a change in the direction of the wind, not taking place simultaneously all over the ice-field, but beginning at one edge of it. After a time all the pieces of the puzzle will get into steady motion in the new direction, but during the change from one motion to the other much relative movement of the pieces will take place. They will rub against one another, and twist round, in fact

FIG. 2.—SHACKLETON AND WILD STANDING BETWEEN HUMMOCKS OF ICE.
By courtesy of William Heinemann.

there will be a general readjustment of the pieces before steady motion in the new direction is possible.

There seems to be little doubt that readjustment of the floes during change of wind is one of the chief causes of screwing pack and pressure in the open sea.

As a result of the processes described above, the ice surrounding our ship became extremely uneven. Pressure-ridges of all sizes covered the surface, from the newly formed ridge with its blocks square and sharp-cut, to the old ridge of several seasons, with its outlines softened and rounded by the snow.

The wind formed long snowdrifts in the lee of all the hummocks, often several feet high and many yards in length, rising to a sharp whale-back, which stretched away from the obstacle causing it in extraordinarily beautiful curves. Level surfaces of snow were very rare, and marching with loaded sledges was a matter of great difficulty. On a sunny day the cavities between the blocks, which were often filled with icicles, shone with a wonderful lustrous blue, while during the long hours of sunset light in the winter and spring, the delicate tints of the snow surface—pink, grey, or dove-colour—were a never-failing source of delight.

How the "Endurance" was Crushed

But the position of a ship frozen into pack-ice in which constant pressure is going on is very precarious. Towards the end of the winter, when the ice became very lively, it was plain enough that the chances of the *Endurance* escaping unscathed were few. The end came on October 27, 1915, by which time the ship had reached lat. 69° S. She became involved in an area of very bad pressure, and was finally crushed and had to be abandoned. The party formed a camp on the ice and continued to drift north. Summer was approaching, and the temperature was becoming higher again, so that the smaller pieces into which the ice was broken by the disturbances to which it had been subjected did not freeze together again. To this may be attributed the fact that, after the beginning of November, pressure became very uncommon, at all events within the radius of observation from the camp. The ice-floes were probably small enough to accommodate themselves to changes of motion without great pressure.

A Camp on Drifting Ice

But although the floes were no longer frozen together, they still kept too close for us to be able to take to the boats, for the ice was now approaching the projecting hook of the Graham Land Peninsula, and was thus unable to spread out. The drift continued during the summer months of December, January, and February. Seals and penguins, which had been rare during the winter, again appeared in large numbers in the leads, while whales of various kinds were frequent visitors to a large pool which lay near the camp. At the end of March 1916 the ice-floes bearing the tents passed within sight of Joinville Island and continued on their way across Bransfield Strait. Once to the north of Joinville Island the ice began to break up rapidly; it became exposed to a slight swell from the open sea, the large floes cracked parallel to the crests of the swell, twisted round, and cracked again, and soon became uncomfortably small for a camp.

The drift had been steadily to the north ever since the crushing of the ship, for seven degrees of latitude, or about 490 miles, but in the middle of Bransfield Strait, about sixty miles south of Elephant Island, the floes began to drift rapidly to the east, and there seemed every prospect that we should be carried out to sea, to the leeward of the most easterly of the South Shetland Islands, before the ice opened out enough for any boat-work to be possible. But on the 9th of April the opening came, and six days later we made a landing on Elephant Island, whence Sir Ernest Shackleton started on his historic journey to South Georgia, to obtain relief for the rest of the party, which remained on the island until his return on August 30.

This article is concerned only with one aspect of the boat-journey to Elephant Island. During these days we were able to observe the last stages in the decay of the pack. Throughout the drift there had been remarkably little decay of the floes. Some melting had gone on below the water during the warmer months, and the surface snow had softened to a small extent, but on the whole the ice appeared very much the same in April 1916 as it had done in April 1915. But once it was exposed to the action of the ocean swell in Bransfield Strait, the disintegration was astonishingly rapid. The camp floes were already only forty or fifty yards square when the party left them, and during the boat-journey similar floes, packed together in long streams, were passed. On the sides of these streams which were exposed to the open sea, rapid destruction was going on; the ice above the water-line and a foot or so below it was being eaten away, the remaining portions of the floe taking on fantastic forms, some of them of a strange beauty, while the sea was strewn with ice-débris of all kinds.

The ice had been under observation for a period of fifteen months, during which time it had drifted over 1,200 miles; how far it had come before the *Endurance* was caught in it it is impossible to say, but the end of the long journey was now reached.

Why Pack-ice Drifts

Only one other aspect of the drift can be considered here, that of its motive power. This at first sight seems to be simply the wind. When the wind blew the ice moved approximately before it ; if it was calm, the ice was nearly always stationary. The most rapid drift was a distance of eighty-four miles in six days, during a strong southerly gale, while for a whole month immediately preceding this gale, during which the winds had been light and variable, hardly a mile had been made to the north. The wind is doubtless the most important cause of the drift, but a more complete examination of the observations than has hitherto been possible will almost certainly bring to light an outstanding effect due to current. The direction of the drift was always a little to the left of the direction of the wind. This is due to the rotation of the earth, and a similar deviation to the right of the wind direction was noticed by Nansen during the drift of the *Fram* across the North Polar Basin. The drifts of both the *Endurance* and the *Deutschland* in the Weddell Sea show strangely parallel courses up to about lat. 65°, when the *Deutschland* took a sudden turn to the east. The average rate of drift of the *Deutschland* was greater than that of the *Endurance*, the latter being more to the west, and presumably closer to land. It is difficult to escape the conclusion that the unknown coast of the Weddell Sea must run nearly parallel to the drift course of these two ships, and the probability of any sea passage from the Weddell Sea out to the Pacific south-west of Graham Land seems small. If such a passage once existed, it is probably now filled up with shelf-ice similar to that of the great Ross Barrier.

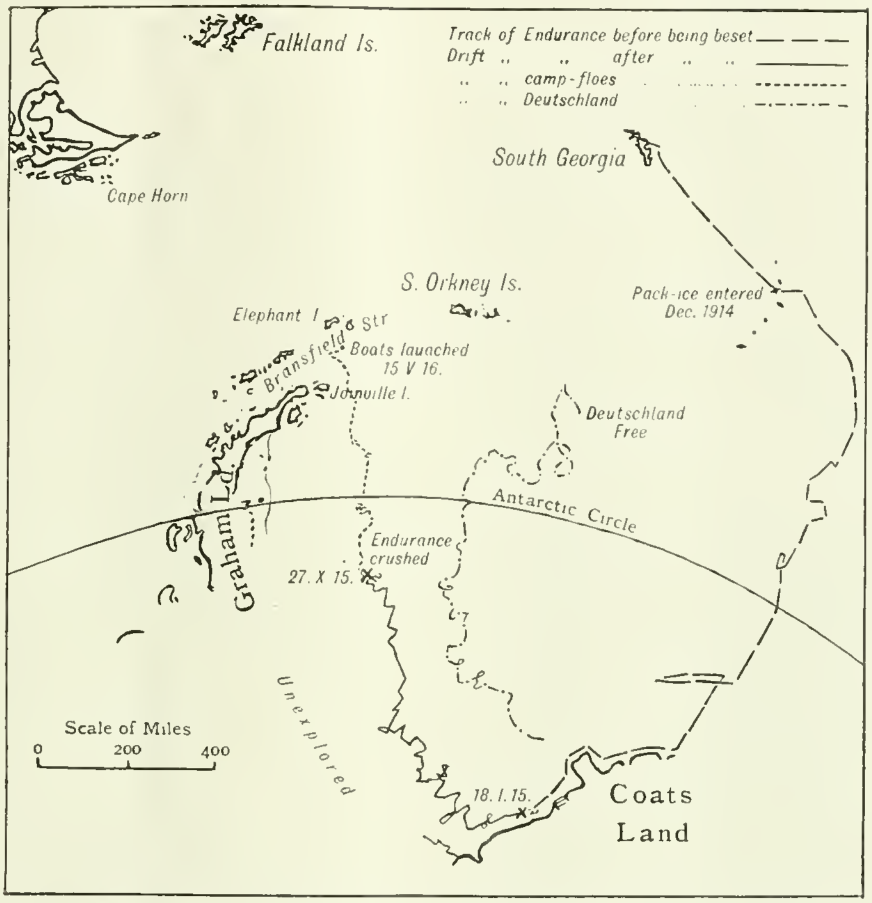

FIG. 3.—MAP OF THE WEDDELL SEA ILLUSTRATING THE DRIFTS OF THE *ENDURANCE* AND THE *DEUTSCHLAND*.

The various problems raised by the drift of the *Endurance* which have been touched on above have been considered very fully by Mr. J. M. Wordie, geologist to the expedition, to whose work reference should be made by those interested in the subject.

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The Empty Tomb of a Russian Emperor

The latest discovery, made in August 1922, concerning the probable end of the Emperor Alexander I (commonly called the Blessed) of Russia.

By Princess E. M. Almedingen, B.A.

THE official date of the death of the Emperor Alexander I, commonly called "The Blessed," [1] of Russia is November 19, 1825, and it is said to have taken place at Taganrog, a small town in the south of Russia.

It was rumoured that the Tzar had died from some infectious disease, and, in consequence of this, the coffin, said to contain his body, was sealed up immediately. Very few of the courtiers were enabled to see the corpse, which was soon afterwards transported to St. Petersburg, and there laid to rest in the usual burial-ground of the Sovereigns of All the Russias—the magnificent Cathedral of SS. Peter and Paul, erected by Peter the Great within the precincts of the famous fortress bearing the same name. However, soon after the Emperor's burial, strange things began to be whispered with regard to the fate of the much-beloved Tzar. People said that he had not died at all, but had just disappeared in order to consecrate the rest of his days to God's service and work and prayer. These rapidly spread rumours, together with the slender evidence which existed even then concerning the authenticity of the body placed in the coffin, gave birth to a series of legends based upon a firm popular belief that the Emperor was still alive and would come back to rule his people once again.

A good reason for these beliefs was naturally suggested by the very character of the Sovereign, a character so strange and weird that it has hardly ever been subjected to analysis by historians. Merejkovsky rightly called him "the mystic on the throne."

The fact that the Emperor's body was seen but by very few people was accepted by the majority as final evidence; and the "Tzar Blagosloweny," or "the Blessed," continued to be alive for his subjects, who, for the most part, considered the rule of his brother, Nicholas I, to be a temporary one only. But all these rumours and easily woven legends had hardly any basis to stand on until they became centred round one mysterious person, living buried in the deep and silent Siberian forests—the famous hermit, "Fedor Kusmitch."

Historically speaking, this hermit's real identity was never proved, and there is now hardly a chance that anything further will come to light with regard to him. The life he led in Siberia was that of a hermit, or, rather, of a recluse. No one knew how he had come there or what he had done in earlier years. That he was a person of importance is sufficiently proved by the fact that the Emperor Nicholas I would often come to him, seeking his advice on many a difficult matter concerning the government of Russia. Many witnesses have stated that the Emperor's attitude to the hermit, as shown on these occasions, was one of profound respect, not to say reverence. The occasional visits of Nicholas I to the strange hermit's cell only served to deepen the mystery. But in spite of the laborious researches of Russian historians, two facts have never been sufficiently proved: first, that Alexander I actually died in 1825 at Taganrog, and, secondly, that the strange Siberian hermit, who lived in his solitary cell for many years, acquiring a very wide reputation for piety and saintliness, was the same person as Alexander I. The legend of Fedor Kusmitch, however, found great favour with the Russians, and many great authors took it as a subject for their writings. First among these authors one should mention Leo Tolstoy and his famous story entitled, *The Legend of Fedor Kusmitch.*

Though historically unproved, the strange legend of an Emperor, giving up his crown and sceptre and all the splendour and glory of court life for the sake of dedicating his life to God in the dark depths of the Siberian forests, in order, as he thought, to expiate his own sins and to plead with God for his country, is quite acceptable to anyone familiar with the Russian soul in general and with the person of Alexander I in particular. The Tzar's spirit grasped the idea of *podvieg*,[2] and all the numerous religious influences under which he had spent his life might very well have led him to a desire to make a great *podvieg* of his life itself. For the present, however, we must be satisfied with the following facts brought to light about one year ago.

In the summer of 1922, during the period of the sequestration of Church plate, a decree was issued by the Petrograd Soviet appointing a Committee of experts for the inspection of all Imperial tombs. It was surmised by the authorities that the Sovereigns might be found buried with their regalia and other gems of great value. This decree was duly executed, and every Imperial tomb was opened and the contents of every coffin duly searched. As could well

[1] The title of "Blessed" was given to Alexander I, after his ultimate victory over Napoleon, by the people of Russia. Napoleon was nothing less than Antichrist in the popular imagination, and the fact that he was conquered by their Tzar brought the Russians to a firm conviction that the Sovereign was endowed with some peculiar graces of God. Hence the origin of the appellation "Blessed."

[2] *Podvieg*—undertaking of some particular work for God's sake; sometimes dedication of one's whole life to God.

be expected, this gruesome search led to very few, if any, practical results,[1] but it made public the not unimportant fact of an Imperial grave being found empty, namely, that of Alexander I.

The coffin was certainly there, just as it was brought in some time in December 1825, carefully sealed up. But when the seals were broken, it was discovered that no body had ever lain there, whilst the heavy weight of the coffin was explained by a few lumps of lead found in it. This discovery destroyed the previous theories that either a dummy lay in the coffin when it was brought from Taganrog to St. Petersburg, and there given the usual funeral with all the pomp and honour due to an Emperor, or else that the coffin did contain a real body, though not that of the Sovereign, who most probably had not died at Taganrog. The magnificent white marble sarcophagus, so splendid in its simple severity, with a single letter "A" in gold letters on the top and a small elaborately carved imperial crown, covered the space of 6 ft. and disclosed nothing but an empty coffin with the original Taganrog seals.

This discovery, naturally, can in no way prove the identity of the person of Alexander I with the strange hermit "Fedor Kusmitch." Yet it does away with the supposition that Alexander's death really took place on that foggy day in November 1825 at Taganrog. And, perhaps, this accidental discovery of an empty tomb within SS. Peter and Paul's walls will give to a future historian of Russia some ground to stand on when he investigates the fate of one of the most mysterious royal characters of the nineteenth century.

Modern Industries—IV

Gem-gathering in Ceylon

By T. Bowyer-Bower, M.Inst.C.E.

Objects of the Industry

Travellers to the Far East have no doubt felt interested in the wonderful display of gems, precious and semi-precious, at Colombo, Ceylon, but probably few have given any thought to the question where these stones have come from or how they were obtained. The average traveller is satisfied if he comes to the conclusion that the majority of stones offered by the dealers have their origin in Birmingham or other places where glass is cheap. As a matter of fact, gems guaranteed by a reputable dealer in Colombo can be relied upon as genuine. For many years the main source of certain precious stones and semi-precious stones that are sold in the European market has been in Ceylon or Burma. There is a very large business done every year, especially with India, in semi-precious stones. Before the war the writer had occasion to investigate the gem industry. The sales of five of the principal dealers showed just on £60,000 profit on their sales alone. As there are hundreds of small dealers and smugglers who rely upon gem-selling as a livelihood, it can be imagined that the business is by no means a small one. The main supply in Ceylon comes from the Ratnapura district of the island, known as the Low Country. The gems are secured by the hand-washing of alluvial deposits, and also in the beds of streams. A gemmer, on finding stones, sells to an agent on the spot. Agents travel the country round, hunting up any new find, and great competition arises as to who the happy purchaser will be. The agent again sells to the dealer and sometimes directly to a foreign purchaser. The dealers also sell, and resell, among themselves. I know of a particularly fine amethyst that at one time or another belonged to every dealer of importance on the island. The last purchaser, despairing of ever selling it at anything like the price he paid for it, had it cut, and to his astonishment he was then able to boast of a very fine profit by selling it to a private purchaser.

It is exceedingly difficult, even to the expert, to give a definite opinion as to how a gem in the rough will cut; and even the gem-cutter may not always cut the gem so as to give the greatest effect of light and colour. A gem of fine quality may be entirely spoiled by being wrongly cut; in the same way one of poor quality may be greatly enhanced in value by good cutting. Fig. 1 shows the gem-cutters in the foreground, and at the back the shadowy figure of the man at the polishing disk. The art in cutting is perhaps more noticeable in the blue zircon, which, to be effective, must be of uniform colour when looked through from every angle of vision. The zircon is one of the least appreciated and yet one of the most beautiful gems, in my opinion. It ranks at the head of second-grade gems, and has the flash and lights of a diamond, and at the same time can be obtained in many beautiful colours and shades.

There is no hard-and-fast method in Ceylon of recovering gems from the earth's surface, such as the custom of recovering rubies in Burma, or diamonds in

[1] Soon after this search had taken place, a rumour was spread among the lower population of Petrograd to the effect that "the Soviet authorities had taken out the body of Peter the Great and were on the point of selling it to some American millionaire," but this rumour was unfounded, and the body of the great Emperor is left to lie in peace in his accustomed place.

South Africa. Every native who owns a small plot is a gemmer. He works at gemming during the dry season when he has little other work to do, and he looks upon gem-recovery as a pastime which is possibly remunerative.

How did the Gems come There ?

The geology of the gem districts of Ceylon is not of a complex nature. The whole island may be taken to be of igneous origin. Granite and gneiss outcrop and protrude everywhere, showing evidence of some huge force that must once have piled the mass of rock to an enormous height, very much higher than the present surface. The gems, no doubt, may have been *in situ* originally, but I have never seen or heard of a gem being found embedded in rock. The only instance which leads one to suppose that the gems were once *in situ* is that garnetiferous granite is found in quantities. On the cooling of the igneous mass, fissures and cracks and the lamination of the rock surface took place, and during the thousands of years of denudation and weathering, hundreds of feet in thickness must have been washed away to the lower valleys and into the huge fissures. The rock-débris became further decomposed and now forms the present surface ; such débris is termed "latterite deposit," and provides the soil that now produces tea and rubber. Where the rock-débris has fallen down to a still lower level it has become a much more decomposed latterite, and is heavily charged with kaoline which no doubt came from decomposition of the felspar in the granite. There are very few gems found in the high elevations—i.e. on the top or steep side of the hills—but a few are found in the beds of mountain streams and natural rock-riffles or depressions. The natural inference would be that the gems, being of greater specific gravity, would have remained more or less near the spot where they were released ; but I am inclined to think that, where a gem was encased in a piece of rock, it was carried away to the lower level, and there washed and rolled about until disintegration took place which released it. Those that were freed at the higher level became encased in the alumina-mud, or clay, or kaoline, which gave the mass sufficient buoyancy to be deposited in the lower gutters. These two processes would explain the fact that gems are seldom found at their spot of origin.

FIG. 1.—CUTTING AND POLISHING GEMS.

Scooping, Washing, Vanning

As we have seen, the lower gem deposits are of a very decomposed nature, being at the present day invariably under water, sometimes at great depth. The gemmer in consequence only works during the dry season, when the water is low, so that he can scoop up the wash with a basket or old pot or a coconut shell ; this is a very tedious and unreliable method, but I have never seen any more modern method used. I saw a case where the gemmer was confident that a very fine gem existed on his plot in about 10 ft. of water, and he dived down with a coconut shell for the precious stone ; he had worked his gem plot on this system, he said, for some years, and still hoped one day to get the gem. The total amount of ground, hand-dredged and brought to surface by this primitive method, was about $1\frac{1}{2}$ tons in three years.

The stream-washing is much more simple and methodical. The stream-bed consists wholly of well water-worn granite, and of boulders and pebbles of gneiss and garnetiferous granite ; below the surface-layer the boulders and pebbles are embedded in latterite, much decomposed and with a considerable quantity of kaoline ; it is in this that the gems are found. The process of recovery is by washing in a conical-shaped basket made of cane, about 2 ft. in diameter at the top and 12 in. deep to the apex of the cone. A curious feature of these baskets is that they are water-tight. They hold about 30 lb. of wash-gravel : the gravel is placed in the basket, which is then filled with water by submersion ; a rotary and at the same time a tilting motion is applied, which causes the lighter particles to come to the surface and pass out over the basket edge. This process is repeated until only a small quantity of the wash-gravel concentrates are left in the cone of the basket. This is then dumped on to a mat and hand-picked for any gems it may contain. All natives in the gem-districts are expert gemmers in their own crude way. The men and boys generally do the digging ; the women are certainly the best washers I have ever seen ; in fact, they can get a perfect concentrate either by washing with water or by dry-vanning.

In dry-vanning they use a basket made like a housemaid's dusting-pan, and by dexterously throwing up the gravel repeatedly in the air and with a jerk, they pass all material of light specific gravity on to the ground and collect the heavy concentrates at the base of the basket. Impressed with the expertness of the vanning, I made a test of gems from three separate minerals, thorianite, and ordinary gravel. The vanner never lost a single gem or thorianite crystal, and then, to show how expert she was at her job, separated the gems from the thorianite. Fig. 2 shows this woman at work on this actual vanning test.

I have just said that the method of washing gem-deposits is crude. This only applies to the working of the wash-gravel, not in the recovery of the concentrates. The crude methods of working the deposits seem due to the natural laziness of Eastern races. They like better to squat or sit down and scoop up small quantities with a coconut shell than to stand up and use a shovel. Time is no object to them, and gemming is only a pastime to keep them occupied when they have nothing else to do after the rice harvest is in, and it may bring in a few rupees should they be lucky.

The Order of Merit in the Stones

The classification of precious and semi-precious stones varies considerably in the minds of mineralogists or jewellers. The mineralogist classifies according to the chemical composition, crystallisation, hardness, and specific gravity. The jeweller, disregarding these essentials, jumbles them up and classifies them mostly by colour, disregarding the fact that the composition is of the highest importance for value. As the principal demand of gems is for ornamental purposes, it matters very little whether the gem is hard or not, or whether it is in the first or second classification. Effect is the purchaser's object, with the satisfaction of knowing it is not wholly common glass. There is a considerable amount of fraud in the ornamental-stone business,

FIG. 2.—A WOMAN SEPARATING GEMS.

since present-day chemists can now construct, from the analysis of real gems, glass substitutes that only an expert can detect. Even sapphires and rubies can be made with all the essentials of the natural stone, i.e. of corundum-construction. In the case of very small stones these reconstructed stones no doubt will pass as genuine, but in the larger specimens there is always to be seen a very minute bubble or air-space which proves their origin. The following classification by Kluge may be of interest ; I quote it from *Precious Stones*, by Dr. Max Bauer and L. J. Spencer, M.A.:

A. *Gems of the First Rank*

Hardness between 8 and 10. Consisting of pure carbon or pure alumina, or with alumina predominating. Fine specimens of very rare occurrence and of the highest value.

1. Diamond.
2. Corundum (ruby, sapphire, etc.).
3. Chrysoberyl.
4. Spinel.

B. *Gems of the Second Rank*

Hardness between 7 and 8 (except precious opal). Specific gravity usually over 3. Silica a predominant constituent. In specimens of large size and of fairly frequent occurrence. Value generally less than stones of group A, but perfect specimens are more highly priced than poorer specimens of group A.

5. Zircon.
6. Beryl (emerald, etc.).
7. Topaz.
8. Tourmaline.
9. Garnet.
10. Precious opal.

C. *Gems of the Third Rank*

These are intermediate in character, between the true gems and the semi-precious stones. Hardness between 6 and 7. Specific gravity usually greater than 2·5. With the exception of turquoise, silica is a prominent constituent of all these stones. Value usually not very great, only fine specimens of a few members of the group (cordierite, chrysolite, turquoise) have any considerable value. Specimens worth cutting of comparatively rare occurrence, others fairly frequent.

11. Cordierite.
12. Idocrase.
13. Chrysolite.
14. Axinite.
15. Kyanite.
16. Staurolite.
17. Andalusite.
18. Chiastolite.
19. Epidote.
20. Turquoise.

Where the Machines failed

Fig. 3 shows a small mechanical washing plant in a rubber plantation in Ceylon. This was erected with the idea of testing large deposits. These machines were no doubt very useful for diamond-bearing deposits where there was only a small percentage of heavy particles, viz. diamonds and garnets, but on deposits such as are found in Ceylon they were not a very great success, as they were really too accurate in their work and collected too large a concentrate. The consequence was that the concentrate was too bulky to sort by hand, and ordinary hand-basket washing had to be done so as to reduce the bulk. The same photograph shows the machine in the background, the small native carriers on the right carrying the gravel to the machines, and the native basket-washer in his pit of water, washing, with the basket in the foreground. It was not an uncommon occurrence to obtain half a bucketful ($1\frac{1}{2}$ gallons) of dallam (imperfect gems and crystals of all kinds) per working-day. This when sorted would give probably one or two good specimens (generally sapphires), $\frac{1}{2}$ to 1 lb. of corundum crystals good enough for cheaper ornaments or for crushing down for cutting-powder, and the balance a mass of pretty glistening stones useful for cheap ornaments. It is a question why the public prefer glass ornaments when they could get a real crystal from the residues of gem-washings. The cutting of gems is not such an expensive operation as most people think. A very few shillings will cut the stones of average size to be ready for mounting.

Fig. 3.—Mechanical washing plant in a rubber plantation.

Water-work

As in all granite-formations, there is an abundance of water. This has been the prime power that has re-

leased the gems from their original bed and distributed them far and wide over the undulating or flat ground. There are very many beautiful spots in the gemming districts still quite undisturbed by the tourist. I obtained a very fine specimen of Ceylon ruby in one stream a little lower down from a fall, during my course of inspection, but the Ceylon ruby is not counted of first quality as it is pale in colour; the public prefers the pigeon-blood colour of the Burma ruby.

The most valued stones in Ceylon are the sapphires and zircons of deep blue, and yellow to pure water-white, topaz, amethysts, cats'-eyes, star-rubies and star-sapphires, alexandrites, olivines, and the like.

Wanted—Mineralogists

From the view of the mineralogist, Ceylon offers perhaps the best hunting-ground. It has received little or no attention from the mineral financier and comparatively few men of mineral knowledge have troubled about it. There are miles of streams and square miles of deposits that have only been partially scratched by the native. There is still plenty of scope for anyone interested in gems to go and fill his pockets with many beautiful stones, and, if luck comes his way, of obtaining something really beautiful and valuable for his holiday.

At the British Association's Meeting

The meeting of this famous association, which has come to be looked on in the light of a national institution, was held this year at Liverpool from September 12 to September 19. It was, perhaps, one of the most interesting meetings ever held, since the place chosen is not only one of the greatest ports in the world, but is also an important centre of industry and the seat of a university, and this fact appears to have influenced many of the speeches and discussions. We regret that the meeting was held too late this year for us to include anything like a full account of it in this number. We shall give our readers further accounts of the work got through by certain of the groups in subsequent numbers of Discovery. Meanwhile a short summary will not be out of place.

The Electrical Structure of Matter

The characteristic note of the meeting was sounded on the first day by Sir Ernest Rutherford, this year's President, who in the early stages of his speech on the above subject commented on the benefits of the union of pure and applied science. "If the fundamental researches of the workers in pure science supply the foundations on which the applications are surely built, the successful practical application in turn quickens and extends the interest of the investigator in the fundamental problem, while the development of new methods and appliances required for technical purposes often provides the investigator with means of attacking still more difficult questions."

Passing on to the main thesis of his address, Sir Ernest summarised with wonderful lucidity and comprehensiveness the advances made in man's knowledge of the structure of matter since the last Liverpool meeting twenty-seven years ago. The atomic theory was first announced by Dalton. Next the researches of Lord Kelvin and others resulted in rough estimates of the "absolute dimensions and mass of the atoms," which made scientists realise the minute size of the atom and which led some of them to believe that the atomic theory could never be proved by direct experiment.

Up to this point only vague ideas were held as to the possible structure of the atoms, but there was a general belief that they "could not be regarded as simple unconnected units." In 1897, however, the discovery of what is now called the electron, "a mobile electrified unit," infinitely more minute than the lightest atom, and of the fact that it could be freed from all the atoms of matter by various methods, strengthened the belief, started by Mendeleef's studies of the periodic variations of the properties of the elements, that it was probably the common unit in the structure of atoms. Scientists now began to attack tentatively on these lines the absorbing problem of what the atom consisted of, the work of Sir J. J. Thomson, who boldly took the view that it must be "an electrical structure, held together by electrical forces," contributing greatly to the development of this subject.

Meanwhile the study of radio-activity and the discovery of radium revolutionised "our whole conception of the atom and of the magnitude of the forces which held it together." The extraordinary radio-active elements, such as radium and uranium, enable scientists to study the changes originating actually in the heart of their radio-active atoms—changes which are due to atomic explosions of power infinitely greater than that to be found in ordinary physical or chemical processes. For instance, the so-called α-particle expelled in the majority of these explosions has now been proved to be a charged helium atom, and this has revealed "the importance of helium as one of the units in the structure of the radio-active atoms, and probably also in that of the atoms of most of the elements."

These extraordinary bodies, then, have provided us with much new knowledge of matter and also with tools for further exploration, as in the case of α-particles, which, used as projectiles to bombard and explore the atom's interior, have "exhibited its nuclear structure," and "led to artificial disentegration of certain light atoms."

The detection of the effect of a single atom was first

illustrated by Sir William Crookes in the case of these α-particles which produced flashes of light in a dark room when they fell on a screen coated with crystals of zinc sulphide. Other and more recent methods of detecting and counting individual particles electrically and photographically were described by Sir Ernest Rutherford, notably that of Mr. C. T. R. Wilson for observing the track through a gas not only of an α-particle, but also of other types of penetrating radiations.

Passing on to the various methods of fixing the mass of a single atom and the number of atoms in any given quantity of matter, Sir Ernest mentioned in particular that devised by Millikan, depending "on comparing the pull of an electric field (*i.e. an area charged with electricity and therefore magnetic*) on a charged droplet of oil or mercury with the weight of the drop." This method with the aid of electrochemical data gives wonderfully accurate results, and Sir Ernest considered it to be one of the most notable experimental achievements "in an era of great advances."

The President went on to deal with the idea of the atomic nature of electricity and its connection with the problem of the structure of the atom, giving the evidence for the belief that the atoms of matter are built up of two electrical units, the electron and the hydrogen nucleus—a belief which may be described superficially with a fair degree of accuracy as showing that matter is really a sort of solidified electricity.

Next he returned to the question of the detailed structure of the atom, covering far too wide and technical fields of physics and chemistry for so short a summary as this—Geiger's and Marsden's study of the scattering of α-particles, the work of Laue, the Braggs, Moseley, and Chadwick, and the application by Bohr of Planck's Quantum Theory to the problem of the electronic structure of the atom. Very roughly speaking, the modern conception of the atom reached through these researches is of a minute nucleus surrounded by a swirling group of electrons, differing greatly in number and movements according as to whether the type of atom is light or heavy. An analogy, not to be pressed too far, is that of likening the nucleus atom to a "solar system where the sun corresponds to the nucleus and the planets to the electrons."

A survey of that "comparatively unexplored territory," the nucleus of the atom, followed, including Sir Ernest's and Dr. Chadwick's experiments, Soddy's and Aston's work on isotopes, and researches into the formation and disintegration of atomic nuclei (which also give rise to various interesting theories as to the heat of the stars and stellar evolution, and to the conservation and liberation of energy within the universe).

We must here leave Sir Ernest's survey "of this great period of advance in physical science"—a survey, the value and importance of which, linking up as it does into a homogeneous whole the vastly complicated and widely divergent work of a large number of physicists and chemists, and that puts a completely new interpretation on the structure of matter throughout the universe, can be but little realised from this fragmentary outline.

Science and Transport

Sir Henry Fowler's address to the Engineering Section followed an interesting discussion on the preceding day between the members of his section and the psychologists on *Vocational Tests for Engineering Trades*, and in commenting on the practical application of our vast store of scientific knowledge to engineering he emphasised in his address the "great need for men with the education, the capacity, and the imagination necessary to use this scientific knowledge for the advancement of our profession." Most difficult of all to instil is "that imagination which allows one to see the way in which the knowledge available can be applied in a practical way."

Transport and its Indebtedness to Science is a big subject to cover. "The transportation which aids civilisation is that which cuts down the wastage of power to a minimum and which reduces the time occupied in carrying this out," was Sir Henry's able definition. Taking also the definition in the *Encyclopædia Britannica* of Science as "ordered knowledge of natural phenomena and of the relations between them," he went on to show how in this way transportation has been dependent upon it.

He surveyed the methods of artificial propulsion from the time that Jonathan Halls tried to use a steam engine in a boat on the River Avon in Worcestershire (1736–7) to the present day—the early steam engines and their evolution, the turbine, railway electrification, the internal combustion engine, modern ocean and air transport. On the subject of early railways he recalled a story about Stephenson showing the quickness with which he could apply a known principle to a different object—a faculty which in this case invented the steam whistle.

"On the Leicester and Swannington Railway, which followed the Liverpool and Manchester, one of the Newcastle locomotive drivers—R. Weatherburn—at a level crossing ran into the cart belonging to an old lady, destroying her eggs and butter. Upon his return to Leicester, and reporting this to Stephenson, he was at once told to go down the town to a trumpet-maker and get him to make a trumpet which could be blown by steam."

Among other matters Sir Henry considered at some length the evolution in the materials employed for transport machinery and engines, alloy steels, light alloys, and the work of himself and his colleagues, which has been exceedingly successful in prolonging the life of the railway locomotive crank axle.

Education of the People

After the thoughtless gibberish and "hot-air" of politicians and other second-rate intellects on the question of education, Professor Nunn's speech on the above subject came like a refreshing breeze. He stated the steadily growing belief that "every member of society has an equal title to the privileges of citizenship; and, secondly, that the corporate strength of society should be exerted to secure for him actual as well as theoretical possession of his title."

Education, he considered, should aim at enabling a man

to realise the "fullness" of life. Less attention should be paid in education to what has become almost the sole idea during the decades following Darwin's teachings which looked upon all biological phenomena "as incidents in a perpetual struggle wherein the prizes to be won or lost were the survival of the individual and the continuance of his species." That idea—the doctrine of "efficiency"—should be put in its right place and not raised above the equally needed teaching of the "creative" activities.

Taking the "emergent" view of life and nature, Professor Nunn advocated the need for bringing up our children as good Europeans, but also for shaping them into "that particular brand of good Europeans who are rightly to be called good Englishmen." English letters, English traditions in the arts and crafts, a revival of the old English dances, should form part of the budding Englishman's education. This would not, of course, exclude foreign traditions and art.

Insufficient space precludes a fuller précis of Professor Nunn's many interesting remarks. We particularly liked his definition of a school as a "place where a child, with his endowment of sensibilities and powers, comes to be moulded by the traditions that have greatest significance in the life of to-day," and the way in which he polished off the fears existing in the minds of some persons, that a liberal education will make people unwilling to work, by a quotation from one of Dr. Johnson's sayings: "While learning to read and write is a distinction, the few who have that distinction may be the less inclined to work; but when everybody learns to read and write it is no longer a distinction. A man who has a laced waistcoat is too fine a man to work; but if everybody had laced waistcoats, we should have people working in laced waistcoats."

Some Aspects of the Present Position of Botany

In contrast to the majority of the presidential addresses was Mr. Tansley's account of recent tendencies in botanical research, for its appeal was intentionally directed to specialists in this branch of botany and it bore little on the wider problems of science. Botanical research has become divided into a good many branches, one of the two chief stems, the older, being concerned with morphology (the study of the form of plants), and the more recent with physiology (the study of the normal functions and phenomena of plants). Mr. Tansley urged that danger lay in the professional workers in botany specialising so greatly in one branch that they took little heed of another, and advocated closer co-operation between all branches both in teaching and in study.

Other Addresses and Discussions

Among the other addresses Dr. Vaughan Cornish's review of *The Position and Opportunity of the British Empire*, Mr. Julian Huxley's paper on *The Physiology of Development in the Frog*, Professor Elliot Smith's lecture on *The Study of Man*, Professor Newbury's address on *Egypt as a Field for Anthropological Research*, and Sir W. H. Beveridge's speech on *Unemployment and Population*, attracted great interest.

The discussion between members of the Geographical and Anthropological sections on *The Methods of Anthropology in Relation to the Social Sciences* provoked some lively speeches, as also that between members of the Economic Science and Psychology sections on *Psychological Assumptions underlying Economic Theory*.

E. L.

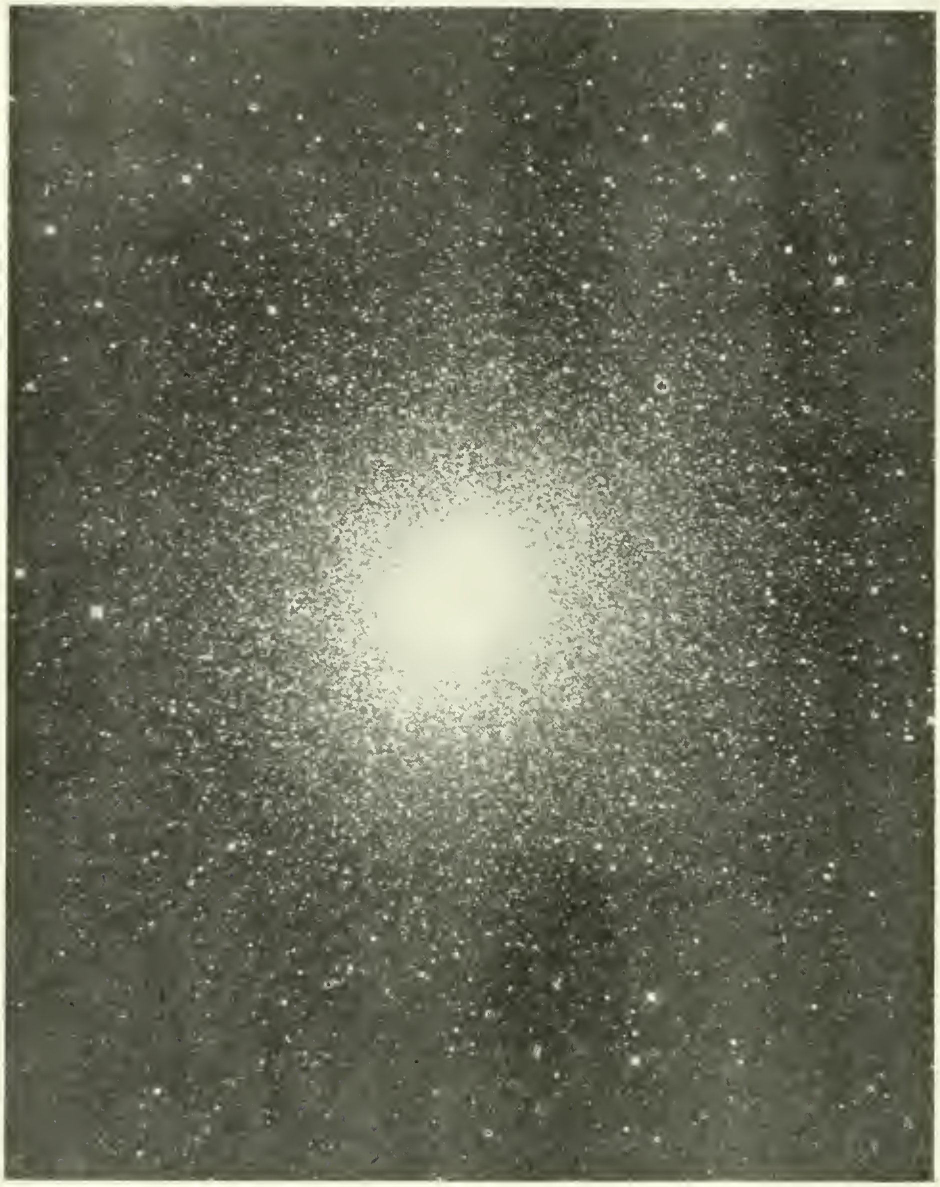
Among the Stars
A Monthly Commentary
The Distances of Star-clusters and the Scale of the Universe

As is well known, Professor Harlow Shapley's important conclusions concerning the extent of the stellar universe are in great measure dependent on the reliability of the distances of globular clusters which he has deduced by various methods. Fundamental to Dr. Shapley's scale of distances is the assumption that the brightest stars observed in star-clusters are comparable in absolute brightness—or intense luminosity—with the giant stars in the part of the stellar system comparatively close to the Sun, and that the Cepheid and cluster-type variables —stars which undergo changes in brightness visible in star-clusters—are likewise giant stars. This assumption has been questioned by Dr. Curtis, the American astronomer, and more recently the late Professor Kapteyn and Dr. Van Rhijn have urged that the Cepheids in clusters are probably dwarfs. The two Dutch astronomers argued that the large proper motions—i.e. real motions independent of the apparent motion caused by the Earth's changes of position—of certain cluster-type variables in the stellar system indicate large parallaxes and low luminosities. Hence they concluded that the cluster-type variables in clusters are dwarfs, and that Dr. Shapley's distances for the globular clusters are eight times too large. Thus the great cluster in Hercules, according to Dr. Shapley, is 36,000 light-years [1] distant; while on the scale adopted by Kapteyn and Van Rhijn, the distance is reduced to 4,500 light-years.

In a recent *Circular* issued from Harvard College Observatory, Professor Shapley discusses the crucial question raised by Kapteyn and Van Rhijn. Does the large proper motion of fourteen faint Cepheids of the cluster type indicate that they are comparatively near, and therefore of low luminosity, or are the space velocities of these stars actually high? Dr. Shapley points out that several of these variables have large radial velocities, that is to say, are moving rapidly in the line of sight to or from our system; and this fact alone affords strong evidence that these stars have great absolute velocities in space. In the case of the variable RR Lyræ, Mr. Van Maanen has measured its parallax as well as its

[1] A "light-year" is the distance travelled by light in a year. It travels 186,000 miles in one second.

proper motions and has shown that it is of great intrinsic brightness and travelling very rapidly. Dr. Shapley accordingly reaches the conclusion that "the cluster variables of the galactic system appear to have such abnormally high velocities in space that the method



THE GREAT CLUSTER (M 13) IN HERCULES.

of computing mean distances used by Kapteyn and Van Rhijn is of low weight." The average velocity of these stars, Dr. Shapley states, is comparable with the average velocity of globular clusters. "This may indicate that many of the cluster variables of the galaxy were originally members of the same extra-galactic cluster or cloud." In a recent paper Dr. R. E. Wilson discusses the proper motions of seventy Cepheid variables. From a study of the known radial velocities of a few, Dr. Wilson deduces the velocity of the Sun relative to these stars, and from their average peculiar motion he computes the mean parallaxes. The computed distances are in close agreement with the figures reached by Dr. Shapley. Dr. Wilson's investigation is therefore of considerable significance, and his results are strongly confirmatory of Dr. Shapley's estimate of the scale of the stellar system.

A Near Stellar Neighbour

The spectroscopic parallax of the fifth-magnitude star Epsilon Indi has been determined at Harvard. The distance deduced from this measurement is seven lihgt-years. If confirmatory results are obtained, it will be safe to conclude that this small star is one of our nearest stellar neighbours. Recent research has shown that in the region near to the Sun, and probably throughout the stellar system, the dwarf stars considerably outnumber the giants.

A New Theory of the Origin of Mercury

Dr. A. C. D. Crommelin has recently drawn attention to a remarkable theory concerning the origin of the planet Mercury, which, he holds, seems "to explain a good many points that are otherwise puzzling." According to this suggestion, Mercury was originally a satellite of Venus. The Earth and Venus are so nearly alike in size that it is not unlikely that they originally rotated at about the same rate. The solar tides, which according to Darwin's theory brought about the disruption of the Earth and the birth of the Moon, would be still more potent on Venus, and it would not be surprising if a considerably larger satellite were born. This huge satellite would very quickly recede from the planet from which it was torn, and in the case of a planet revolving so near the Sun as Venus, the satellite would be likely to escape from the control of the planet and would become a planet on its own account. Dr. Crommelin remarks that the long rotation period of Mercury tends to support this tentative hypothesis, and the fact that the albedoes—or degrees of whiteness—of the Moon and Mercury are nearly the same suggests that they may have had a similar history. The speculation is a daring one, but it must be confessed that it is rather attractive.

Professor Hale's Retirement

There will be widespread and genuine regret all over the scientific world at the announcement of the retirement of Dr. George E. Hale from the post of director of the Mount Wilson Observatory on grounds of ill-health. Dr. Hale will continue as honorary director, but the duties of the office will be discharged by Dr. W. S. Adams, who becomes the second director of the famous institution. Dr. Hale is a comparatively young man so far as astronomers go. Born in 1868, he came into prominence at the age of twenty-four through his invention of the spectroheliograph. At the early age of twenty-seven he was appointed director of the Yerkes Observatory, and in 1905 he was transferred to the mountain observatory on Mount Wilson, with the foundation of which he was closely associated. His researches at Mount Wilson have been chiefly in solar astronomy, in which department he has done enduring work. But no less valuable has been his work in directing the activities of an institution which has been largely responsible for the vast widening of the scientific horizon during the twentieth century.

HECTOR MACPHERSON.

Reviews of Books

PLANT-LIFE IN THE DISTANT PAST

Studies in Fossil Botany. By DUKINFIELD H. SCOTT, LL.D., F.R.S., etc. Vol. II, Spermophyta. Third Edition. (21*s*.)

This volume, which deals with seed-bearing plants, has been in part rewritten; knowledge has advanced and views have changed. It is mainly concerned with the higher types of vegetation preserved in association with our coal seams, and the author contents himself with a comparatively short account of some of the more important genera discovered in strata younger than those of the Palæozoic era. The flowering plants, the dominant class of Spermophyta at the present time, do not come within the scope of the book. This selective method of treatment has its advantages: the student is introduced to a phase of evolution about which we have acquired in recent years abundant information; he is not bewildered by descriptions of obscure, problematical fossils which tell us little that is botanically interesting.

Dr. Scott's researches into the structure of Palæozoic plants have not only thrown a flood of light upon the wonderful vegetation of the remote past, but they have largely contributed to the recognition of the fact that students of botany cannot afford to neglect types that have long ceased to exist if they are interested in the problems of evolution. His work is conspicuously scientific in the best sense; he combines sound scholarship with caution, and he has the ability to make a difficult subject clear to readers whose knowledge of botany is comparatively slight. The book is hardly an elementary treatise; it is an admirable, critical review of the present state of our knowledge of those sections of the plant kingdom chosen for special treatment. A particularly valuable chapter is that on General Results, in which the author summarises all the available information on the older vascular plants. The more we know of the floras of the past, the more difficult becomes the problem of evolution. A superficial acquaintance with extinct types of vegetation may lead to the conclusion that the records of the rocks clearly support the orthodox conception of a progressive development from the simple to the complex, but when we become familiar with the extraordinary complexity and astounding variety of types illustrated by the plants which formed the forests of the Coal Period, and contrast them with their nearest living relatives, we wonder more and more whether it will ever be possible to construct a satisfactory history of the vegetable kingdom from the fragmentary documents within our reach. "In our complete ignorance, now realised, of the methods of Evolution, we cannot hope for very definite success in tracing its course. A more tentative and diffident tone seems to be demanded in discussing phylogenetic problems, and may be found, it is hoped, in the present issue of this book."

The second volume, like the first, is well illustrated and provided with adequate references to literature. The types dealt with in the "Studies" are not merely interesting as examples of structural complexity and of the high stage of development represented by members of the older floras; they are striking illustrations of the uniformity through the ages of the main features of plant-mechanism revealed by the almost perfect sections of petrified stems, leaves, and seeds preserved in the later Palæozoic rocks. We can not only reconstruct the framework of the plant-machine, but we can use our knowledge of the physiology of modern plants as a guide to the conditions under which the vegetation of remote ages had its being.

In the concluding chapter the author deals briefly with the question of the relation of the flowering plants to the older Cycadean types known as the Bennettitales ; he favours an affinity between these two groups. While it would be rash to deny the possibility of any real relationship, the opinion may be expressed that no evidence has so far been presented which enables us to understand the evolution of the flower. The tendency to connect group with group is now much less apparent than formerly. Evolution has operated along many different lines, and it is not improbable that the history of the now dominant flowering plants has had but little connection with that of the group which to a large extent occupied the corresponding position in the later Triassic, the Jurassic, and early Cretaceous periods.

A. C. Seward.

A NEW INTERPRETATION OF DREAMS

Conflict and Dream. By W. H. R. Rivers, Lit.D., F.R.S., etc. (Kegan Paul, *12s. 6d.*)

When Professor Freud first enunciated his psychology of dreams, he laid down certain very definite principles which were claimed to be applicable without exception to all dreams, whether of children or of adults, of normal or of neuropathic individuals ; but to many of the workers who entered the new field that had been opened up it seemed, as more varied psychological data were obtained, that the original "pioneer" theories were too rigid, and various attempts were made to expand them. Freud himself, largely as a result of a study of the war neuroses, made several important modifications in his theories, and these were recently published in his monograph, *Psycho-analysis and the Psychology of the Ego.*

The late Dr. Rivers, working upon his own dreams and those of patients suffering from war neuroses, came to the conclusion that all dreams could not be explained as the symbolic fulfilment of a repressed wish (as Freud had originally claimed), but might express any emotional state and might be regarded in general as an attempted solution of a conflict, either conscious or unconscious.

Dr. Rivers totally rejects Freud's theory that the form of the dream is determined by a psychological process (the "censorship") which allows the disturbing thoughts which would wake the sleeper to appear only in the disguised and undisturbing form of the dream, and, instead, he holds that the form of the dream is to be explained solely by the fact that in sleep we revert to a more primitive mode of thought, of which the dream is the natural and dramatic expression. The conception of regression during sleep, which was originally emphasised by Freud, is expanded by Dr. Rivers into the attractive theory that the more deeply we sleep the farther we recede from our waking and familiar self and the more primitive and distorted become our dreams. This theory is the corollary of the conception of "psychological levels" formulated by the author in his book *Instinct and the Unconscious.*

Dr. Rivers's early death, that has caused so great a loss to English psychology, left the present work unfinished, and it is almost certain that he would have considerably altered and modified the latter part of it. As it stands, it is of the highest interest to the specialist and a valuable commentary for the general reader who is acquainted with the Freudian theories, but may perhaps have remained unaware of any alternative explanation of the phenomena with which they deal.

F. A. Hampton.

BOOKS ON SCIENCE

Metals and Metallic Compounds. By Ulick R. Evans, M.A. Four Volumes. (Edward Arnold & Co., *21s.*, *18s.*, *14s.*, and *18s.*, respectively.)

This is a comprehensive work on the chemistry and the physical chemistry of those elements which are usually regarded as metals. It is not so detailed as the many-volume treatises of Newton Friend and Mellor, and differs from these works not only by its omission of an account of the non-metallic elements, but also by its emphasis on metallurgy and on such subdivisions of physics and chemistry as pertain to that subject. The first volume, which no doubt caused the author most trouble, and which is very good, deals with general chemistry, the study of the metallic state, electro-chemistry, the corrosion of metals, and radio-activity. Volume II deals with the metals of the "A" Group, Volume III with the transition elements, and Volume IV with the metals of the "B" Group. The space devoted to each metal is divided into three main sections. The first gives an academic description of the metal and its compounds and contains a summary of the methods of analysis. The second section deals shortly with the terrestrial occurrence of the metal in question, starting with its origin in the rock-magma, and discussing the probable mode of formation of the chief ores and minerals. The third and longest section is of a technical character. The author starts with the ore, follows the metal through the processes of concentration and smelting, and finally considers the practical uses of the element, its alloys and its compounds, trying throughout to make this section a correct survey of industry carried on at the present time.

A book like this one, written obviously to be of use to readers and not to placate imagined critics, which avoids going into the history of every detail as large treatises tend to do, and which gives sufficient references to the literature and sufficient credit to the more prominent workers without surrounding the facts in a sea of proper names, will of course find an audience. It should be useful to advanced students of inorganic and metallurgical chemistry, to engineering and industrial chemists, and indeed to all students of the book's subject-matter who have not the works of Dr. Mellor or Dr. Newton Friend. The chief criticism I have against the book is that it contains matter which is not only irrelevant to the author's subject, but which is better described elsewhere. The sections in the introductory chapter dealing with analytical chemistry, with radiation and chemical equilibria might well have been omitted. And what has radio-activity, well though it is summarised, or the fractiona-

tion of the rare earths, to do with the subject? For the best books, even the best textbooks, are written when the author writes what he knows about and from his own angle, and withstands the desire to say a few words on everything theoretically embraced by his subject. Mr. Evans has done a great work in producing this useful work single-handed, but a critic must affirm that he need not have taken four volumes to say his say.

Atomic Structure and Spectral Lines. By ARNOLD SOMMERFELD. Translated from the third German edition by Henry L. Brose, M.A. (Methuen & Co., Ltd., 24*s.*)

This work of the professor of theoretical physics at Munich is the standard book on atomic structure in use on the Continent, and contains an accurate and singularly luminous account of the subject up to the year 1922. It is for the advanced student only; indeed, "quite a lot of algebra" is necessary for its finer points to be understood. All students of physics and of physical chemistry are indebted to the translator and to the publisher for this book in its English dress. Its place is already with the great monographs on Physics which in our day include Rutherford's *Radio-active Substances*, the Braggs' *X-rays and Crystal Structure*, Bohr's *Theory of Spectra and Atomic Constitution*, and Aston's *Isotopes*.

Stories of Scientific Discoveries. By D. B. HAMMOND. (Cambridge University Press, 6*s.*)

Mrs. Hammond gives in this excellent book short accounts of ten scientists of the front rank and their work. The book has been carefully compiled from the original biographies and is most interestingly written. It is pleasant to have an account of scientific workers which is not marred by untempered enthusiasm, or by the irrelevancies and inaccuracies of the hack writer. The book, in addition, is beautifully printed and the illustrations are good. The authoress has chosen her subjects from different branches of natural science, and selected those lives which are interesting both on the human and on the scientific side. The subjects chosen are Priestley, Lavoisier, and the chemical revolution; Count Rumford; Herschel and the discovery of the planet Uranus; Jean Fabre; Faraday and his electrical discoveries; the Curies and the discovery of radium; Darwin, Wallace, and the theory of evolution; and finally Pasteur and his work on germs and inoculation. The book is heartily recommended to our readers.

Light and Colour. By R. A. HOUSTOUN, M.A., D.Sc. (Longmans, Green & Co., 7*s.* 6*d.*)

This book deals in a popular manner with those aspects of light and colour which the author, a distinguished worker in the subject of Optics, has found to appeal most to the man in the street. It contains chapters on the spectrum, the nature of light, invisible rays, the structure of atoms and of stars, the primary colours, colour-blindness, colour photography, the light of the future, photochemistry, phototherapy, and the psychology of colour. I do not know any book of a popular or a semi-popular kind, published since Sylvanus Thompson's *Light Visible and Invisible*, that covers the ground so thoroughly or that will so well meet the needs of those interested in light as this one.

Dr. Houstoun has an advantage over many writers of books of knowing his subject inside and outside, up and down, and he has succeeded in writing not only accurately and with interest, but with a good deal of humour. And though he is evidently very familiar with the literature of the past, from which he makes several pertinent quotations, his standpoint is, of course, the modern one. He has not much to say for journalists who "explain Einstein." He thinks the soundest attitude with regard to that scientist's theory is to "wait and see." "While Einstein's formulæ are mathematically accurate, it is no disparagement of his great work to suggest that he has not correctly interpreted them. Christopher Columbus died under the impression that it was a new route to the East Indies he had discovered, not America." . . . "Some of the authors who wish to upset Fresnel's work in order to explain the new deflection . . . have about as much sense of proportion as the man who would burn down the house to boil his tea-kettle."

The chapters on colour-blindness, on the light of the future, and on the psychology of colour will be found most interesting by the general reader.

The Discovery of the Nature of Air and of its Changes during Breathing. By CLARA M. TAYLOR, M.A. (G. Bell & Sons, 1*s.* 6*d.*)

This is the second of the Classics of Scientific Method, of which Dr. Singer's *The Circulation of the Blood* was the first. We may apply to the second what was said of the first, "authentic, well written and well produced," and add "wonderful value for the money." This one, by the Head Mistress of the Northampton School for Girls, contains a history of the knowledge of respiration from the time of Harvey (1578–1667) to the time of Lavoisier (1743–1794), and contains a description of the views and experiments of these men and of van Helmont, Robert Boyle, Lower, Mayow, Hales, Stahl, Joseph Black, and Priestley. It is suitably illustrated. This book is heartily recommended to all readers interested in the history of science.

The Structure of the Atom. By E. N. DA COSTA ANDRADE, D.Sc., Ph.D. (G. Bell & Sons, 16*s.*)

Dr. Andrade was in Sir Ernest Rutherford's laboratory in Manchester in the years before the war, and was consequently in touch with the workers whose experiments and ideas led to the theory of the structure of the atom now widely accepted. He has done advanced students of physics a service in selecting the important facts and theories, and in setting them forth in a clear and accurate manner that shows throughout independent thinking and judgment. This book and Sommerfeld's translation noticed above are at present the only all-embracing works on this subject in English. Dr. Andrade's book is more suitable for a first reading of the subject, for it does not treat details in so extended a manner as Sommerfeld,

and it brings the chronicle down to a more recent date. The great contribution of radio-activity and experimental work in connection therewith to our knowledge of the atom receives here its due share of importance, and altogether it is a satisfactory and well-balanced compilation.

Textile Chemistry: An Introduction to the Chemistry of the Cotton Industry. By F. J. COOPER. (Methuen & Co., Ltd., 10s. 6d.)

The first twelve chapters of this book describe the elements of chemistry, and contain a large number of diagrams exceedingly well drawn by the author. The last six chapters describe the application of chemistry to textiles. It should be found very useful for the students for whom it has been written. The first part of the book would serve as an introduction to chemistry which is anything but bookish for young students.

A. S. RUSSELL.

The Outline of Science. Edited by PROFESSOR J. ARTHUR THOMSON. Volume II. (George Newnes, Ltd.)

The second volume of the *Outline of Science* is fully worthy of its predecessor. It covers a great variety of matter, but it teems with interest in every page. There is rather more physical science and less biological science in this volume that in Volume I, but all the chapters are well worth reading. One may single out specially that by Sir E. Ray Lankester on Bacteria. It is the most complete and scientific account of any of the groups which are dealt with. It is written with all Sir Ray's grasp of the subject, and the historical introduction is masterly. It would be worth while reprinting as a small tract.

Another signed article is that by Mr. Julian Huxley. He has taken an extremely difficult subject and has treated it in due proportion. But the subject is too large for some twenty pages, and one feels that the article is dealing with regions beyond the grasp of the average intelligent non-specialist.

The chapters on applied science, dealing with Electricity, Wireless Telegraphy, Telephony, and Flying, are adequate and are far better illustrated than many of the biological articles. The figures, in fact, throughout the book are very unequal. Some of the reproductions of photographs do not do justice to the originals.

The book closes with a chapter on the science of thought by the editor, and one need hardly say that it is original and stimulating. On the whole we are not at all surprised to learn that the American edition of this work is selling by some tens of thousands.

A. E. SHIPLEY.

MISCELLANEOUS BOOKS

Chanties in Greek and Latin. By W. H. D. ROUSE. (Oxford: Basil Blackwell, 2s. 6d.)

In this book the Head Master of the Perse School, Cambridge, offers a collection of songs "which the children of ancient days might have sung," and he has fitted them to various traditional tunes. A few of them, such as "The Swallow Song" and "Torty Tortoise," have been adapted from ancient material; others—free translations, paraphrases, and songs which have originated in the author's own head—have been done into Greek and Latin from the English, German, French, etc., originals. Altogether a very delightful collection, which should prove most useful in teaching the two ancient languages in schools through dance and song, and which anyone with a fair knowledge of the classics will easily understand and enjoy.

Dreams of an Astronomer. By CAMILLE FLAMMARION. Translated from the French by E. E. Fournier d'Albe. (T. Fisher Unwin, Ltd., 10s. 6d.)

An imaginative astronomer's voyage through space which, despite its picturesqueness, imparts much interesting knowledge to the average reader of the realms of space and their occupants.

The Wheelwright's Shop. By GEORGE STURT ("GEORGE BOURNE"). (Cambridge University Press, 12s. 6d.)

The well-known author of *The Bettesworth Book* and *Memoirs of a Surrey Labourer* gives a comprehensive picture of the trade that was his own livelihood and that of some of his companions during the thirty-six years that he plied it.

Flying Round the World. By MAJOR W. T. BLAKE.

Major Blake is sufficiently well known to our readers to need no introduction. In this book his attempt to fly round the world in 1922 is graphically described, and illustrated with interesting snapshots. Major Blake had to retire from the flight in India owing to appendicitis. The final disaster, described by Captain Macmillan, in which he and Mr. Malins nearly lost their lives in the Bay of Bengal, holding on to their sinking plane for three days and nights, reads like an exciting story in a magazine, but is obviously unexaggerated in every detail. Nearly 11,000 miles were covered in the flight.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Bibliography of English Language and Literature. By A. C. PAUES. (Bowes & Bowes, Cambridge, 6s.)

The Travels of Fa-hsien (399–414 A.D.). Re-translated by PROF. H. A. GILES, M.A. (Cambridge University Press, 5s.)

Ancient Man. By HENDRIK WILLIAM VAN LOON. (Harrap, 5s.)

SCIENCE

Pitman's Radio Year Book, 1923. (Sir Isaac Pitman & Sons, Ltd., 1s. 6d.)

Wireless World and Radio Review. (Wireless Press, Ltd., 4d.)

Fabric of Thought. By G. E. M. ENNIS. (Effingham Wilson, 6s.)

Handbook of Physiology. By W. D. Halliburton, M.D., etc. (John Murray, 21*s.*)
The Vault of Heaven. By Sir Richard Gregory. (Methuen, 6*s.*)
A Manual of Histology. By V. H. Mottram. (Methuen & Co., Ltd., 14*s.*)
A Manual of Practical Dactylography. By Dr. Henry Faulds. (The *Police Review* Publishing Co., 2*s.*)
The Cause of the Rotation of the Earth, Planets, etc. By Samuel Shields. (Sir Isaac Pitman & Sons, Ltd.)
Science and Civilization. Essays arranged and edited by F. S. Marvin. (Humphrey Milford, Oxford University Press, 12*s.* 6*d.*)
The New Natural History. The Twenty-fifth Robert Boyle Lecture. By Prof. J. Arthur Thomson, M.A., LL.D., University of Aberdeen. (Humphrey Milford, Oxford University Press, 1*s.*)

Correspondence

GERM TOXINS AND ANTITOXINS

To the Editor of Discovery

Sir,

Perhaps you will permit me to call attention to a rather remarkable statement in the article *From the Vague to the Concrete*, by Professor D. Fraser Harris, in your July number.

On page 187 Professor Harris writes: "It was soon isolated in pure cultures [the *Bacillus pestis*], grown in artificial media, and its toxins and antitoxins became chemical entities."

Such a statement may easily mislead the uninformed into thinking that germ toxins and antitoxins (or some of them) have been isolated, that they can be weighed and measured like other "chemical entities." This is certainly not the case. If they exist at all they must be definite chemical bodies, yet they cannot be isolated. Their formulæ are not known, they respond to no chemical reagent, and no system of chemical analysis can demonstrate their presence, either in the living body or in culture. They are quite as imaginary and unreal as phlogiston, and like phlogiston there is not the slightest probability of their ever passing from the vague to the concrete.

A little farther on Professor Harris declares that "in 1892 the bacteriologist Pfeiffer isolated the organism of influenza." How does this square with the fact that the organism of influenza is still being sought for?

Altogether the germ-theory of disease seems to be built on wild assumption. Hypothesis is piled on hypothesis in the effort to make theory fit the facts, just as epicycle was added to epicycle in the effort to make the geocentric theory fit the facts of astronomy. Germs are just as likely to be a consequence as a cause of disease, and quite certainly their toxins and antitoxins have never been proved to exist.

Trusting you will afford space for this letter,

Yours, etc.,

J. Campbell.

10 Fauconberg Road,
London, W.4.

[Our correspondent, in entertaining a philosophical doubt as to the truth of the germ-theory of the origin of certain diseases, has taken up a position which we find a little difficult to understand. There is not space here for a full discussion of the great mass of knowledge on the subject, which is fully discussed in such admirable textbooks as Muir and Ritchie's *Bacteriology*. The three facts—that a certain bacterium is found in the organs of an animal suffering from a definite disease, that this bacterium can be grown on an artificial medium, and that on injection into a healthy animal the disease is again recognised, together with the fact that this animal develops certain recognisable peculiarities in its blood which are associated with immunity from further attacks in many cases—provide a basis for the theory difficult indeed to undermine.

It is true that the chemical analysis of the poisonous substances, known as toxins, which a bacterium manufactures, has so far proved impossible. But these toxins behave exactly like other well-recognised poisons such as "ricin." It is only very recently that many of the complicated substances which are connected with the processes of life have been analysed and expressed in chemical formulæ; "Biochemistry" is in its infancy. A poison, however, is none the less a chemical entity because we are ignorant of the arrangement of its elements; we know well enough what those elements are. So far from agreeing that "there is not the slightest probability of their ever passing from the vague to the concrete," we believe that such a happy consummation becomes each day more probable, and that, when we know their chemical formulæ and can manufacture antitoxins at our will, a very great advance will have been made in the treatment of disease.

As regards the organism of influenza, there is, admittedly, some discussion. This is not unnatural when we remember that the disease itself is far from easy to recognise, save in epidemics when great numbers of individuals present the same symptoms. Some recent work has gone to show that a "filter-passer" is associated with influenza; but at present Pfeiffer's bacterium has not definitely been ousted from its position of dishonour.—Ed.]

DEATH-IMPULSES

To the Editor of Discovery

Sir,

As a result of holidays I have obtained my July number of Discovery over a month late, so I have only just read Mr. Hampton's review of Professor Freud's *Beyond the Pleasure Principle*—a review with which I disagree so strongly that I would be grateful for space in your correspondence columns to put forward another view of this book

The argument of the book is simple. A man dreams fearful dreams in which he goes over an unpleasant past experience, a child sometimes throws away his toys. These are the only two empirical facts on which this theory of death-instincts is based. The theory is not

based on a logical argument from these facts. Roughly it is this: the known facts a and b can be classed together under the name X. Since the class X exists, the hypothetical facts c, d, etc., of the class X must also exist. This is not a caricature of Freud's argument; it is his argument. Since the two facts mentioned above can be observed and may be called *repetition-compulsions*, therefore other repetition-compulsions must exist; in fact the impulse to the reinstatement of the inorganic condition must be inherent in the living organism. Now this is not a logical conclusion, it is a simple fallacy, the old fallacy of giving to a name more reality than is contained in the observed facts which the name originally covered. Freud points to no actually observed death-impulses. He makes a tentative suggestion that sadism may be such an impulse, but realises that all his previous work has made of sadism an impulse of the opposite kind, one belonging to libido or the life-impulses.

Your reviewer speaks of "the conclusions to which an unflinching intellectual courage may lead him" (Freud). But these are not conclusions at all, in any ordinary sense. They are not reached by any process of logical reasoning, but are more closely related to "free-associations"—the polar opposite of logical thinking.

Professor Freud is, I believe, one of the most talented original observers of our time, but I do not think that his permanent reputation will be advanced by those who would take as serious contributions to science these latest fanciful imaginings. Even in his best work there was a tendency to alogical thinking which went side by side with careful observation and cautious generalisation. It was this tendency which has made it so difficult for his work to be appreciated at its true value by more logical thinkers. In his latest work this alogical tendency seems to have taken the bit between its teeth.

It seems better to take this book at Freud's own estimate as "the exploitation of an idea to see how far it will lead," and to regret, perhaps, that so brilliant an investigator prefers such diversions to the task of adding to the body of scientific knowledge.

Yours, etc.,
ROBERT H. THOULESS.

THE UNIVERSITY,
MANCHESTER.
August 15, 1923.

ATLANTIS

To the Editor of DISCOVERY

SIR,

With reference to the Editorial Notes in the August issue, may I be permitted to criticise your usage of the word "Atlantis"? You employ it to denote (i) a submerged continent in the Pacific, and (ii) an ideal civilisation; whereas, as you are doubtless aware, the original Atlantis of Plato's legend was an island continent in the Atlantic, which, subsequent to the decay of the quasi-ideal civilisation upon it, was submerged by a tremendous cataclysm.

That "Atlantean" civilisation was a mythical ideal, similar to that of the "New Atlantis" of Bacon, is no doubt true, though "Utopian" would, I suggest, convey that meaning more precisely; but the use of the word "Atlantis" in connection with a submerged Pacific land-mass is to be deprecated.

In Plato's story as also in the various deluge legends—we probably have, in spite of the much-vaunted Celestial Myth theory, an actual reminiscence of a land submergence coeval with prehistoric man, taking place, as the etymology of the word "Atlantis" suggests, somewhere in the Atlantic region. The various attempted identifications of the submerged area—e.g. with the Dolphin Ridge, with the Palæolithic land-bridge between Great Britain and the European continent (Dogger Bank), etc.—are, at the present time, largely discountenanced; but, at any rate until research definitely demonstrates the entire falsity of the legend, it would be a pity for the original significance of "Atlantis" to become obscured by using the name, even allegorically, in connection with *any* submerged land-mass, irrespective of location in time and space.

In particular, to associate the submergence of a civilised (albeit possibly mythical) Atlantic continent with the breaking up of the Pacific Ocean portion of Gondwana Land, the latter event taking place during the Mesozoic era, ages before the earliest traces of Anthropoids had appeared, is surely scarcely justifiable.

Yours, etc.,
STANLEY A. MUMFORD.

RUNNYMEDE,
11 WELLINGTON ROAD,
ENFIELD.
August 8, 1923.

[It must have been obvious that the notes in question were dealing with two different subjects, connected together to preserve an allegorical continuity. Roughly speaking, in the first six paragraphs we mentioned the geological and other scientific evidence as to the existence of Gondwana Land, which we said "stretched from Brazil to Australia, even including a vast portion, if not the whole, of Africa in its extent" (i.e. occupying considerable portions of what are now known as the Atlantic and Pacific Oceans), which we were surely entitled to consider as our "lost Atlantis"; we also commented in those paragraphs on forthcoming investigations of the Pacific portion of this "lost Atlantis." In the remainder of the notes we passed on to a consideration of the purely ideal Utopias formulated in men's minds from Plato's *Republic* to H. G. Wells's *Men Like Gods*, and in the last sentence we again linked up the matter of the two sections of the notes by stating that a material lost Atlantis was not likely to rise out of the waves again for the investigation of discoverers, but that an ideal Atlantis was gradually taking material shape in our midst.

What it all comes down to is that Mr. Mumford would have liked us to use the name *Atlantis* in its strict association with what was probably "an actual reminiscence (*amongst the ancients*) of a land submergence coeval with prehistoric man," whereas we used it in its less academic and more popularly accepted connotation.—ED.]

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Editorial Notes

THIS month we are promised the excitement of a further penetration into Tutankhamon's tomb. So the winter and early spring will see a revival of interest in the life and civilisation of the ancient Egyptians. Prosperous city merchants will exchange remarks about the new "finds" over their port in the club; elderly dames will attire themselves in dresses "with a touch of the East about them"; there is certain to be a Tutankhamon Tango in honour of the "old boy," who did himself well a few thousand years ago, and for the benefit of the dancing youth of to-day. If one of Mr. Howard Carter's pet canaries dies during the exploration of the tomb, certain spiritualists will be confirmed in their belief that the shades of Tutankhamon have been enraged; and, in any event, the press will again be filled with outcries against the desecration of a human being's resting-place—however ancient it may be. Meanwhile the sellers of Oriental novelties will rejoice at their increased profits, and publishers will rub their hands pleasurably as they launch books about the ancient Egyptians on the expectant public and the public shows its appreciation in cash.

* * * * *

To persons with imagination these extraordinarily successful excavations in Upper Egypt, described graphically in a lantern lecture in London last September by Mr. Howard Carter himself cannot fail to appeal with unusual intensity. Instead of a few fragmentary remains, the finds are so extensive, rich, and beautiful that, looking at photographs of them, one begins to summon up pictures of the teeming life in the Nile Valley of those bygone days. That life has altered little since Tutankhamon's time, despite a new religion and the advent of Western forms of government and officialdom. The Nile still flows through the Libyan Desert and supplies the irrigated stretches of vegetation on either side of it with fertile mud; and the sun continues to shine from blue skies throughout the year, with the exception of an exceedingly few rainy days. In city and country-side you encounter customs and scenes which you would have encountered had you visited Egypt in the days before the Exodus.

* * * * *

Professor Newberry at the September meeting of the British Association, speaking of the modern Egyptians, said that "in almost every circumstance ot daily life we see the Old in the New. Most of the ceremonies from birth to burial are not Moslim, or Christian, or Roman, or Greek; they are ancient Egyptian." In several past numbers of DISCOVERY we have published articles by Miss Blackman on the ways and customs of modern Egyptians, and in this number we print an article by her on *Moslim Saints in Modern Egypt*, which amply bears out Professor Newberry's statement. So many field anthropologists are nowadays turning their attentions—and rightly so—to the study of savage races in the hope of rescuing their religions and social customs from oblivion ere the advent of the white man caused them to disappear, that in recent years the modern Egyptian has been comparatively little studied—indeed he has never been studied in anything like the way that some of the Central African tribes have been studied. Lane's book on the manners and customs of the Cairene Egyptian still remains as the standard work on modern Egyptian life, though it contains no account of the much more interesting *fellahīn*, or peasants. "A

rich harvest awaits any student," said Professor Newberry, "who, knowing the language, will settle and live throughout the year among the peasants in any village or town in the Lower Nile Valley or Delta."

* * * * *

Much interest was aroused by the report at the British Association's meeting that a domestic fowl which had laid a number of eggs, and was to all appearance a hen, had gradually become transformed into a cock. Details of a further study of this strange event are given—in highly technical language—by H. B. Fell in the first number of the new *British Journal of Experimental Biology*. It is in many ways a tragedy—for the presumptuous creature eventually fell into a drain and was drowned. It was a Buff Orpington, "an unremarkable hen," which had raised many of her own offspring. In June 1923 the gradual change which had been coming over it for six months or a year became complete—it looked like a cock with short legs and an unusual stance. It was mated with a hen, and two live chicks were hatched. After its untimely suicide, it was found to be suffering from tuberculosis—which in this instance was the prime cause of the change of sex through disease of the egg-bearing glands. Seven other fowls are described as showing intermediate stages in this change, without evidence of tubercular disease.

* * * * *

Domestic fowl have been known to manifest this disconcerting change of sex for many years; a case was reported by Shattock and Seligman in 1906, and for scientists the chief interest of these observations lies in the light they throw on the origin of sex. In the cases here considered the new glands grew from the membrane covering the egg-bearing glands, known as the peritoneum, and this new growth always started after the destruction by disease of the female glands, or after they had shrunk and ceased to function. No case is recorded of a cock becoming a hen, which would be, from the chicken-rearer's point of view, a far more desirable phenomenon. The change of plumage with change of sex is in accordance with many well-known observations on the transplantation of glands into animals of opposite sex; "secondary sexual characteristics" such as the antlers of certain deer and the manes of lions are due to the internal secretions of these glands. It is probable that such metamorphoses as that described by Dr. Crewe at the British Association meeting are not uncommon among domestic fowl, and it should add a fresh zest to the back-yard poultry-farmer to keep an expectant watch on his stock. But we cannot help being thankful that the seers of ancient Rome, who foretold the future from an examination of the entrails of fowl, never had to come to a definite conclusion from the spectacle of some such intermediate creature as these of the British Association. Or are we wrong?—do we remember a Roman disaster, foretold in the days of Livy by a hen which crowed like a cock?

* * * * *

Our notes in a recent number on the subject of vaccination have induced several correspondents who differ from us to inform us of their own views. They are far from complimentary. In one instance we are stated to have exceeded the wildest statements of the Yellow Press—we understand by that phrase, presumably, such journals as *The Times* and *The Lancet*, whose views on this subject may differ in expression but not in essence from our own. We have received a long series of statistics, and a repetition of several arguments as familiar to our readers as to us; some of them—such as the fact that in some instances vaccination is followed by serious effects to the vaccinated—are undoubtedly valid, but, if vaccination really does prevent wholesale deaths in epidemics, they are not an argument for less vaccination, but for more care in vaccination to prevent contamination of the scratch. Others—in particular a statement that the illness following vaccination is really allied to a peculiarly unpleasant disease other than smallpox—have not a particle of evidence to support them, and are to be compared with the ridiculous statement that the Pasteur treatment for hydrophobia does not cure, but in fact inflicts, the disease. We cannot give space, in a journal of this nature, to a general discussion on a rather trite subject. Those who differ from us must accept our attitude as a confession of faith rather than an attempt to establish a position or controvert the many arguments against vaccination which may be found in journals which are not "yellow."

ACROSS THE JORDAN

Through the great North Arabian Desert, which separates Palestine from the plains of Mesopotamia, lay, for many centuries, one of the great trade routes of the world. In the days when the Caliphs were mighty in Baghdad, many rich caravans brought silks, spices, and precious stones from the East by this route; but the discovery of an alternative route via the Cape of Good Hope by Vasco da Gama in 1497 robbed it of its importance as a line of communication, and to-day it is one of those lost and unknown corners of the world where anything—and chiefly unpleasant things—may happen to the adventurer. In the middle of this desert is hidden the oasis of Jauf, and in the *Geographical Journal* for October 1923 H. St. J. B. Philby, C.I.E., describes his expedition thither on Ford cars. There are two main industries in that desert—the evaporation of brine, to procure salt, which is done on a small scale, and the slaying of neighbours, which is done on quite an ambitious scale. The story of the journey, in an atmosphere of suspicion and revolution, and the excellent photos of this strange and uninviting desert, remind us that, even in this late century, the spirit of the Arabian Nights is still, somewhere, an unpleasant but romantic reality.

Moslim Saints in Modern Egypt[1]

By Winifred S. Blackman

Oxford Research Student in Anthropology; in charge of the Percy Sladen Expedition to Egypt, 1922-3

A MARKED feature in the life of the modern Egyptians is the veneration which they show for holy men and women, to whom miraculous powers have been attributed either during their life-time or after their death. Such a holy person is given the title of *Sheikh* (fem. *Sheikha*). The word *sheikh*, as I explained in a former article contributed to DISCOVERY,[2] means literally an old man; it also signifies the head of a tribe, the leading man in a village, a learned man (i.e. one learned in the sacred writings), and a holy man or saint, living or dead. There are a certain number of these holy men who are venerated all over the country, the cults connected with them having become part of the popular religion. But, besides these greater personages, there are innumerable local saints, who, however, often draw their devotees from localities beyond the boundaries of their villages.

However great may be the veneration paid to a saint in his life-time, the honour he receives after his death is far greater. Among the Moslims it is the custom to erect over the grave of such a person a small white-washed building, crowned by a dome. In many cases a "servant" is also supplied, whose salary is paid out of an endowment in land or money augmented from the donations of those who visit the tomb. This man, or it may be a woman, is known as "the servant of the *sheikh*," and the office often descends from father to son. Besides the land and trees surrounding the tomb, the sacred precincts may include a well, in which case the water is supposed to be endowed with miraculous properties. Sometimes a heap of stones, or a tree or clump of trees, alone marks the last resting-place of a departed *sheikh*, but when there is a domed tomb, a tree or trees are nearly always associated with it. (Fig. 1.)

Every Moslim *sheikh* (at any rate most of those of any standing) has seven tombs, or other burial sites, associated with him. This does not mean that the body of the *sheikh* is actually buried in any one of these sites, though there are many cases when this is so. A dead *sheikh* may appear to some man in a dream, or even when he is awake, and tell him to build him a tomb on such and such a spot, sometimes personally conducting him thither. It may happen that the inhabitants of a village possessing a venerated *sheikh* have been guilty of misconduct, or have offended the holy man by neglecting to pay him the veneration he considers his due. In such a case, it is believed, the *sheikh* will appear to a man in a distant village and instruct him to build him another tomb. The new tomb often becomes more popular and is visited by a larger number of people than the older building. Thus a *sheikh* whose original tomb is in Lower Egypt may also be associated with a tomb or tombs far south in Upper Egypt.

Candles, or the money with which to buy them, form a favourite offering. Such lights are kept burning every night in some *sheikhs'* tombs; in others they are perhaps burnt on one night only in the week—usually a Friday. A number of votive offerings are generally found hanging on a cord or cords stretched across the interior of the building. The gifts display great variety, consisting of glass and bead bracelets, bunches of human hair, handkerchiefs, first-fruits of the corn-fields, and so on. Each one registers an answered prayer, for the people flock in crowds to these tombs on certain days of the week—usually Thursdays or Fridays—generally to make some special request, or with the object of being freed from some disease which they believe the *sheikh* can cure. A childless woman or persons possessed by *'afarīt* (spirits) will come to beg the *sheikh* to intercede for them. Indeed, the performances of certain rites at the tomb may in themselves effect a cure.

Having removed his or her shoes before entering the building, the visitor then walks from left to right round the catafalque erected beneath the dome, three, five, or seven times, reciting meanwhile special passages from the *Ḳuran*. These perambulations accomplished, the servant of the *sheikh* takes a broom, kept for this special purpose, and carefully brushes out all the footprints in the interior of the building.

Sick animals are also brought by their owners to a *sheikh's* tomb, round which they are driven seven times.

A Typical Sheikh's Tomb

In one of the provinces of Upper Egypt, on the lower desert, half-way between the cultivation and the limestone cliffs which form the edge of the upper desert, stands the domed tomb of the *Sheikh* Ḥasan 'Ali. It is surrounded by a low mud-brick wall, which encloses a few small trees, a well, and two or three graves, wherein relatives of the dead *sheikh* lie buried. Pots of *ṣobara* (aloes) also decorate the sacred spot, this plant being believed to bring happiness to the dead. The building is whitewashed and is decorated

[1] Most of the material used in the following article was collected by me in the course of my expedition in Egypt during the past winter and spring, the funds being provided out of a grant from the Trustees of the Percy Sladen Memorial Fund, and a supplementary grant from the Royal Society.

[2] Vol. iv, p. 11, footnote 2.

with line-drawings in red and blue, representing the pilgrimages to Mecca (see Fig. 2). The surrounding desert is covered with the graves of more ordinary folk. These are marked by heaps of sand into which are stuck branches of palm-trees, for palm-branches, like

Fig. 1.—A *SHEIKH'S* TOMB.

the aloe-plants, are believed to be the means of conveying happiness to the dead who lie beneath.

The *Sheikh* Ḥasan 'Ali was only eighteen years old when he died, but from his earliest years he was noted for his piety. He was educated at a small school in his native village, and, as soon as he had learned to read, he spent all his leisure moments studying the *Kuran*. When he died he was buried in an ordinary grave in the lower desert among his dead fellow-villagers. However, one day, when old 'Ali (his father) was squatting on a bench (*mastabeh*), with his head resting on his hand, his dead son appeared before him and caught hold of him by the wrist, saying, "I am very angry." His father said: "Why are you angry, my son?" The boy replied: "Because you have not built me a large tomb, and if you do not do so now, I will go away to another village." "Oh, my beloved son," said his father, "to-morrow morning I will begin to build a fine tomb for you." Young 'Ali held a paper in his hand, and he now presented this to his father, telling him that on it were written full directions for the building of the tomb, together with a specification of the exact spot where it was to be built, and also as to where would be found a well of water, the locality of which was hitherto unknown.

The tomb was built with all speed, the workmen following the instructions written on the paper presented to old 'Ali by his son. The well was sunk on the spot indicated, and the water from it is excellent. The father states most emphatically that he was wide awake when his son appeared to him. When I questioned old 'Ali as to what he had done with the paper, he told me that it had been lost by the workmen.

A small model of a boat is hung up in the *Sheikh* Ḥasan 'Ali's tomb, as in the tombs of most *sheikhs*. This is an ancient custom still adhered to, the boat being called "the ferry-boat."

A certain *Sheikh* Seyd was buried in a dome-shaped tomb near a large town in Middle Egypt. Though his burial-place was not far from the capital of the province, the locality was somewhat inaccessible. Moreover, he was displeased with the people who lived in the village adjacent to his tomb. The *sheikh* therefore appeared one night to a man who lived near to the capital of a neighbouring province and led him to a site in the cultivation, where he instructed him to build him a tomb, pointing out at the same time a spot where he would find a spring of water. Here he commanded the man to sink a well. The tomb was duly built, and it has become a popular resort for all those who seek the *sheikh's* aid, people flocking here in large crowds every Thursday. Though the newer building can boast the larger number of devotees, many still visit the original tomb.

Trying a Thief in a Saint's Well

The *Sheikh* Seyd's well, situated close to the newer building, serves another purpose besides that of supplying the faithful with water. If a man thinks that another has stolen money or anything else from him, he first takes the suspected thief, and washes him in a stream of water, probably in the Baḥr el-Yūsif. He then conducts him to the *Sheikh* Seyd's well, where he will seek the assistance of the "servant of the *sheikh*," who knows at once what is required in such a case and produces a thick rope, such as is used for water-wheels. He firmly knots it round the supposed thief, passing it under his armpits, and the wretched man is then lowered into the well. If he is guilty he simply disappears in the well, and when the servant pulls up the rope, no one is there! If, on the other hand, he is innocent, the servant pulls him up by the rope, which has remained fastened round his body, and releases him. No one would dream of suspecting him after this infallible proof of his innocence. In the event of his guilt being proved, his dead body will probably be found two or three days later in a stagnant pond of dirty water a long distance away from the well into which he had been

lowered. The officials are trying to put a stop to this practice, as so many dead bodies have been found from time to time in the foul water of this pond.

A Mad Sheikh

The *Sheikh* 'Abdu'l-Laṭīf lived in a small village in Fayūm Province, where some of his family still reside. An old man, the son of the *sheikh's* paternal uncle, is well known to me. The *Sheikh* 'Abdu'l-Laṭīf was, in his life-time, looked upon as a *wali*. Insanity is the usual qualification for this high standing among the Moslim saints of Egypt, persons thus afflicted being regarded as the favourites of God. The *sheikh* had a habit of entering the houses of the people at night, after the doors had been locked and while the evening meal was being cooked, for locked doors formed no barriers to the egress or ingress of this holy man. On entering he would immediately eat up all the food; meat, bread, and vegetables, no matter how large the quantity, would all be devoured on the spot. Any glass bottles that happened to be lying about might be included in this repast, for these he would bite up and swallow without drawing any blood There was only one thing he feared, and that was water. If anyone threw a few drops of water at him, he would run away in terror, as fast as his legs could carry him. My informant, Hideib 'Abd-el-Shāfy, remembered him well, and he told me that on one occasion the *sheikh* entered his house after the entrance door had been securely locked, and ate up all the food, including the soup, prepared for the evening meal.

When the *sheikh* died, hundreds of people attended his funeral, and, being a very good man, he made his bearers walk quickly to the grave.[1] Above it has been erected the usual domed tomb which is situated near that of the venerated *Sheikh* Umbārak, for whom a *mūlid* is held once every year (see Fig. 3).[2] One year, on the occasion of this festival, a man climbed on to the outside of the tomb of the *Sheikh* 'Abdu'l-Laṭīf without first removing his shoes. Some of the people standing around remonstrated with him for this act of irreverance, but he replied: "Who is the *Sheikh* 'Abdu'l-Laṭīf? He is nobody!" and refused to climb down or to take off his shoes. However, when he wanted to climb down and join the festive crowds, he found that he could not move, and that, when he tried to do so, his limbs were rigid and his whole body paralysed. On seeing the plight of the wretched man, cries to the *sheikh* were immediately raised. People came with drums and tambourines, others sang and clapped their hands in rhythmic accompaniment to the music, till at last, after about two hours of such intercession, the man regained his power of locomotion, and so was able to move away.

Some time after this exhibition of his power, the *Sheikh* 'Abdu'l-Laṭīf appeared to a man in a village a few miles distant, telling him to build him a tomb there. The people of this village went in triumph to the *sheikh's* native place and exultantly told the inhabitants that their *sheikh* had now come to them.

The original tomb still exists, but it is in a dilapidated state and, no doubt, in course of time it will wholly disappear, unless something happens to revive the veneration formerly paid to the holy man in his native village. Meanwhile, the people of the village where 'Abdu'l-Laṭīf's later resting-place is built hold a *mūlid*, or festival, every year in honour of their acquired *sheikh*.

FIG. 2.—THE TOMB OF THE *SHEIKH* ḤASAN 'ALI.

During the *Sheikh* 'Abdu'l-Laṭīf's life-time he was visited on one occasion by the *Sheikh* Sulimān, who resided in a village some miles distant. Wherever he went the *Sheikh* Sulimān was always accompanied by his faithful servant. On the occasion of this visit the two *sheikhs* conversed together in an unknown language. This roused the curiosity of the *Sheikh* Sulimān's servant, who after the interview asked his master what they had been talking about. The *sheikh* told

[1] If a man or woman has led a good and religious life, when they die they will make their bearers walk quickly to the grave; but if they have led lives contrary to the rules of their religion, they make their bearers walk slowly, as they fear death and the grave, where they will be examined on the following night by the two angels *Nākir* and *Nakīr*.

[2] See my article *Festivals celebrating Local Saints in Modern Egypt*, in DISCOVERY, vol. iv, January 1923.

him that 'Abdu'l-Laṭīf had remonstrated with him for coming to his village and had bade him remain in his own neighbourhood. Doubtless jealousy was at the root of this ill-feeling. A few days later the servant noticed very early in the morning that his master's fingers were all burnt at the tips. He immediately questioned him as to the cause of this injury, and the *sheikh* told him that it was his custom to go every night to all the *sheikhs'* tombs in the neighbourhood and light candles for them, and that while he was engaged in this pious work his fingers got burnt.

The *Sheikh* Sulimān is now dead, but his piety is still remembered. He is buried in his native village, but six other tombs are erected to his memory in various parts of the country. Moreover, the inhabitants of his village hold a *mūlid* every year in his honour.

FIG. 3.—TOMB OF THE *SHEIKH* 'ABDU'L-LAṬĪF (*extreme right*); THAT OF THE *SHEIKH* UMBĀRAK ON THE LEFT.

One of the most celebrated Moslim saints in Egypt is the *Sheikh* Aḥmed el-Bedawi of Ṭanṭa, where a great *mūlid* is celebrated in his honour every year. It lasts for a week and is attended by thousands of people from all over the country. Huge sacrifices of sheep and oxen are made at the saint's tomb on this occasion, while his devotees seize the opportunity of invoking his aid for every possible want, and for protection from every form of evil fortune.

A False Wife Shown Up

The following story connected with the *sheikh* was recounted to me this year by one who vouches for its truth. There was once a *darwīsh* (a member of a Muhammadan religious order) who lived in a village near Ṭanṭa, and whose custom it was to pay a yearly visit to the tomb of the *Sheikh* Aḥmed el-Bedawi on the occasion of his *mūlid*. The *darwīsh* always took sheep and oxen with him to slay at the sacred tomb, besides bringing other offerings.

One year, when the time of the *mūlid* approached, he found himself without any money, and he did not know what to do about his yearly visit to Ṭanṭa; for how could he approach that holy shrine without his customary gifts? The *darwīsh* was married, but his wife did not love him, and she longed to become the wife of a rich neighbour. The *darwīsh* told his wife of the difficulty he was in, owing to his poverty, and when she had heard all, she thought to herself that now was her opportunity to get rid of her present husband and to secure the richer man. Accordingly she went to the rich neighbour privately, told him of the difficulty they were in, and suggested that he should lend them one hundred pounds, on the solemn promise from her husband that he would pay it back on the day that he returned home from Ṭanṭa. In order to make this promise secure, the husband was to swear by the triple divorce that he would fulfil it. Having satisfactorily hatched this plot, she returned to her husband and suggested that he should go to their wealthy neighbour and ask him to lend him one hundred pounds to enable him to attend the *mūlid* at Ṭanṭa. The husband at once fell into the cleverly contrived trap and set off to make his request to the rich man. The latter, after pretending to think over the matter carefully, consented to lend the woman's husband the money, on the condition that he swore by the triple divorce that he would pay back the whole sum on the day that he returned from the *mūlid*. To this the *darwīsh* readily assented.

The poor man and his wife then set off for Ṭanṭa, where they stayed for the whole week of the festival. By the end of that time all the money had been spent on gifts to the *sheikh* and the man had no money with which to pay his debt. He was at his wits' end, for he knew that if he could not produce the hundred pounds, he was bound by the most solemn oath to divorce his wife. But on the last night of his stay at Ṭanṭa, while he slept, a man appeared to him and handed him one hundred and fifty pounds, saying, "Take this and repay your debts." He also told him how bad and false his wife was, and revealed to him the whole of her treacherous conduct.

The *darwīsh* thankfully accepted the money, returned to his house, repaid his debt, and divorced his faithless wife. The man who had come to his aid in this miraculous manner was the *Sheikh* Aḥmed el-Bedawi, who in such ways, it is believed, often helps his faithful

devotees in their time of need. It is said that in the years to come the poor *darwīsh* became rich, and the rich man who married the unfaithful wife became poor.

A Female Sheikh

In one of the provinces of Upper Egypt, close to the desert hills, lives the *Sheikha* Salūḥ. This woman has a great reputation for holiness, and people flock to her, in times of difficulty, from all quarters. Her skin is very dark from constant exposure to the sun, and her head, on which she wears no veil, is covered with a crop of hair, thick and long like the wool of a sheep; from beneath her brows peer dark, sharp-looking eyes. Her clothes are somewhat scanty, consisting merely of a piece of linen rag and a sort of coat. She remains out in this desert solitude all day, and at night, so I was told, she sleeps alone "in the mountain." The people call the often precipitous high-desert hills "the mountain" (*el-gebel*), so she probably takes shelter in one of the natural or artificial caves which exist in great numbers in the hill-sides. On one occasion, when a number of men and women had come to consult her, one of the men asked her what had become of his most valuable camel which he had lost. The *sheikha* at once told him the exact hour in which this loss had occurred, and informed him that one of his sons had stolen it one night and had sold it to a man in another village in the same province. She then told him the name of the man who had bought it, and said that if he went to the house of the purchaser, he would be able to recover his lost property.

Another man then came forward, and, when he had presented the *sheikha* with a small sum of money, she told him his name and the name of his village, though he was quite unknown to her. She also informed him that he had three sons and one daughter—a perfectly correct statement—and said, moreover, that on his return home he would find that his daughter was ill. This information also proved to be quite true, as the man, who is a friend of mine, told me afterwards.

The customs and beliefs connected with these *sheikhs* show many traces of ideas that have come down from ancient times. I hope to deal with these survivals in some future number of DISCOVERY.

FREUD AND HIS CRITICS

AFTER some years of almost undisputed pre-eminence among the pioneers of Psychology, Freud, who first introduced the theories of Psycho-analysis and based on them a system of treatment of neurotics, has been of late submitted to searching criticism. In the *Revue générale des Sciences* for September, and in the October number of *Scientia*, apppear articles by G. Marinesco and Leonardo Bianchi respectively which should be carefully studied by all who are interested in this subject.

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A Working Philosophy of Life

By W. Tudor Jones, M.A., Ph.D.

BERGSON'S doctrines form one of the most simply expressed and untechnical philosophies of the present day. In the original it is as easy to read him as to read a novel, and yet he deals with some of the most fundamental problems of life and existence.

Bergson's Life and Personality

Henri Bergson was born in Paris on the 18th of October 1859, and received an excellent education. He distinguished himself very early in mathematics, and it was through the gateway of mathematics that he entered into philosophy. After a period of lecturing in several schools and universities in France, he was elected in 1900 Professor of Philosophy in the Collège de France, and in 1901 was elected a Member of the French Institute. About two years ago he retired, and his place in the Collège de France has been filled by his well-known interpreter, Edouard Le Roy.

Bergson is not a recluse in any sense whatever. Hard as his work as a student has been, this has not in any way affected his charming personality. He is one of the most modest as well as one of the most fascinating of men. Along with the mental qualities of a man of genius he combines the power of eloquence in a remarkable degree—a power that drew crowds of people to his lectures from all parts of the world. He has been able in a wonderful manner to put his immense learning on one side when it is necessary, and to feel perfectly at ease with humble men and women. The natural, social life of the day is as interesting and important for him as the life of profound meditation over the deepest problems of science and metaphysics.

Is Discovery Possible in the Realm of Mind ?

The world is often apt to conclude that discovery is only possible within the realm of nature. The discoveries in the various domains of physical science have been so extensive and the results have proved so tangible and fruitful that such a mistake is natural enough. Science has illuminated many dark recesses of nature; but this is also true in the realm of mind, and no one in our generation has shown the fact more clearly than Professor Bergson. He has shown us how mind is related to nature on the one hand, and how it is related to itself on the other. The various branches of the natural sciences have their contributions to make with regard to human personality, but they do not exhaust the explanation of it. Discovery

in the realm of mind takes place, according to our author, by taking constant heed, on the one hand, of the play of external forces upon man, and, on the other, by taking heed of what actually occurs within the various forces of the mind itself. The world and we ourselves have to be taken into account before a satisfactory meaning and value can be given to human personality. Any new light cast on the working of the forces of the mind contributes as actual a discovery as the observation of a new star or the behaviour of a new kind of insect-life hitherto unexplored. Let us, then, see what light Bergson has cast on man in his relationship to the universe and to life.

The Universe and Life in Relation to Man

He points out that it is absolutely impossible to interpret the physical universe from the old materialistic point of view. It is impossible here to describe all the evidence of this which Bergson shows to be present in his explanation of the physical universe· He takes matter as something which would have remained eternally stagnant, unchangeable, had it not been that there was some other element present besides a material one, an element which was working upon matter, compelling it to undergo the myriad transformations which have taken place on the face of this earth. This other element is spirit or life. It is the actual work of this higher element which has compelled matter to bend and change into the various forms which we perceive in the physical universe. Ostwald, the great chemist, states something similar with regard to his conception of energy. Had it not been for the presence of energy as the vehicle of matter, no evolutionary process would have happened. We aie, then, warranted in holding that from the very constitution of the physical universe there have been present from the beginning (if there ever was a beginning) two elements, matter and life. Bergson has not as yet spoken of this element, life, in a religious sense, but his results lead to the conclusion that whatever comes out in the physical world must have been caused by something akin to itself, eternally present and active. Here we seem to be on the level of something like a religious idealism in our scientific conception of the universe.

When we pass from his conception of the relation of matter and life to his conception of the origin of life itself, we come face to face with results strikingly similar. He is aware that mechanical and biochemical elements play a very important part in all forms of life, but he would dissent entirely from every attempt made to reduce life to these material elements. Indeed, he would go so far as to say that everything that changes must be more than material. We have already seen that Bergson conceives matter as remaining for ever the same unless life works upon it. Once life starts working upon matter, transformations immediately begin to appear; and if the work continues, matter rises by means of this work of life to ever higher levels on the ladder of existence. Years of investigation in the realm of biology had led Bergson to this conclusion, which is in harmony with that of a large number of the most prominent biologists in all the countries of the world. Life can only be truly interpreted in the terms of life itelf. Bergson here again is insistent on the fact that in every form of life there is present an element higher in its nature than the material, chemical combinations which we find present. The latter are present certainly, but nothing less than *life itself*, by means of its own inherent nature, is capable of enabling these elements to work, and of directing matter along certain definite courses—" first the blade, then the ear, and then the full corn in the ear."

Instinct and Intelligence

Perhaps one of the most important contributions to knowledge which Bergson has made is that which relates to *instinct*. The origin or this he traces to the workings of the element termed life. In his book on *Creative Evolution* the workings of this unexplainable capacity are delineated with a master's hand. The animal has remained at this level of instinct. But it is a level not to be disparaged. The animals, the birds, and the insects are superior to us in many important ways. This fact came vividly to my mind in crossing the English Channel during the month of August of this year. The small boat behaved badly on the choppy sea. Practically all the passengers were wet through with sea-water, and the strong wind made progress difficult. But the gulls were flying around us and, as it seemed to me, thoroughly enjoying the elements and smiling on man's clumsiness and helplessness. We could not fly, and were at the mercy of a poor boat. Bergson shows how at a high stage in the evolutionary process a tremendous change took place. Prior to this change every living thing on the face of the earth lived on its ready-made capacity—instinct. Very probably this ready-made capacity has been gradually weakening in some of the higher apes, who may have found their food without having to call into activity much of the ready-made capacity, since a few rough natural tools enabled them to secure what they required. In any case, *intelligence* came into the world, and the two forms of life separated and have remained separate ever since. The animal continued to live on its instinct; man began to live by his intelligence. This intelligence became the power of creating tools for man's needs. He had now lost a great deal of his instincts, and was forced to

invent aids in the physical world for the satisfaction of his needs. And that has been the story of intelligence, and the story is marvellous. To it we owe the knowledge, the civilisation, the society, the morality, and the religions of the world. No one will deny that on the whole this was a real advance in the life of the world. But, as Bergson points out, although man gained much in this way, he also lost something of enormous value and significance when his instincts disappeared more and more into the dark background of his life. He can invent aeroplanes, but he cannot fly himself; he can construct machines which will carry him at the rate of a hundred miles an hour, but without these aids he is no match for the horse or the greyhound in a race. Bergson shows how helpless man is in other ways as well.

What is to be done? Evidently it is too late to rediscover many of the instincts, but it is not too late to discover something like them—something which pertains to the enrichment of our life and to the enhancement of our ability. Intelligence, being what it is, a tool-making instrument for the preservation and advancement of life, cannot grasp reality from the inside, but only from the outside—in other words, it can only obtain snapshots of reality. Bergson's great point here is to show that intelligence of itself can give us no more than *concepts* of reality. Through it we can know about the thing, but by means of it alone we cannot be present at the very heart of the thing and *actually be* the thing we know about. It is at once evident that to *know about* things on the one hand, and to find, on the other hand, that we do not really participate in the very enjoyment of the things we know about is a sign of something lacking in man.

Intuition

Man's inward life has not become, on the whole, more joyous and more able than it was 2,000 or 10,000 years ago, and, if emphasis is not laid on something besides intelligence, his life will never become richer, fuller, and more joyous. Bergson shows that life can transform itself and find a richness and a depth of which the ordinary individual has no inkling. How? By intuition. Intuition does not mean with Bergson any ready-made experience, but it does mean the potentiality for an experience which in the mental realm may mean what instinct has meant in the physical realm. This point of Bergson, from the psychological point of view, is an important discovery. We knew of something like it before in the realm of religious experience, but unfortunately we could not prove whether it was a truth or an illusion. Bergson shows that by "ruminating" or "chewing the intellectual cud" over an idea sufficiently deeply and sufficiently long, the idea gets saturated in the instinctive possibilities of our nature, and thus the idea becomes intuition. The idea is no longer an object of contemplation with an interval between us and it; it has now become a real part of ourselves. We thus see the difference between a *relative* knowledge of a thing and an *absolute* knowledge of it. "A comparison of the definitions of metaphysics and the various conceptions of the absolute leads to the discovery that philosophers, in spite of their apparent divergencies, agree in distinguishing two profoundly different ways of knowing a thing. The first implies that we move round the object; the second that we enter into it. The first depends on the point of view at which we are placed and on the symbols by which we express ourselves. The second neither depends on a point of view nor relies on any symbol. The first kind of knowledge may be said to stop at the *relative*; the second, in those cases where it is possible, to attain the absolute." (*An Introduction to Metaphysics*, p. 1.) There is no doubt that the author means that life cannot develop on its deepest level without periodical withdrawals from objects of sense. A great part of human life has to be spent in close connection with objects of sense. This is the portion of man: through the sweat of his brow or the pain of his hand he shall eat his bread. We cannot live without the constant use of the tool-making capacity. But Bergson would insist that "man doth not live by bread alone." He is meant not only for work, but also for enjoyment and the realisation of his own personality. He now sees that a stirring of the deeper nature, physical and mental, is requisite; that the *external* world has to be shut out at times and the world *within* us explored; that contemplation on what seems to be of value must play a part in life if we are to pass from relative to absolute knowledge.

This seems to me to be one of the main messages for the present generation. Ideas are necessary—ideas of objects in the external world. There ought to be a constant desire to know, especially to know the meaning and value of the objects which pertain to our particular vocation. And such knowledge can be taken into the mind when we are not actually at work in the world; it can be pondered over, and its value for the vocation and for the world can be seen. When this happens there will be no need to call anybody to do his work properly. A farm-labourer, for instance, will come to see that his driving the milk-cart to the station is not just to make money for his employer or to earn his own income, but is one of the countless necessary daily events in the vast scheme of the world's life; the milk he drives to the station will be conveyed by train to London, and will be consumed by a worker in the Metropolis the next morning. A postman will come to look on his job

as not merely handling lists of writing wrapped in envelopes and pushing them through letter-boxes, but will see that he is the agent in a complex process, by which news of great importance is passing from human being to human being across hundreds or even thousands of miles—news, the collective value of which will shape the world's destiny and his own as well. These are rough and simple examples, but they suffice to show that the deeper values we possess of the work have now become our intuitions, and our soul will be always in what we do.

But, also, we are called away at times from our work by the deepest mind within us. Ideals and aspirations which we *know*, but which we have not as yet realised as a genuine part of our personality, present themselves before the mind. The mind reflects upon these with "intellectual sympathy" and, if this is continued long enough, the ideal begins to burn within us. A complete transformation takes place in life. The man now *is* the ideal realised. It is at once clear that he is not the same kind of man *after* such an experience as he was before it. The teaching contains a religious significance which seems akin to the deepest meaning of the Christian Gospels.

The Nature of the Soul and Man's Future

From what has already been stated it follows that Bergson conceives of man as possessing in body and mind two different qualities working in the closest possible relation. His arguments that mind and memory are other than cerebral movements and functions are, in the writer's belief, unanswerable. In some of his later writings man is shown, in the development of his life, in some such manner as has been here sketched, to be creating a life, within the *reality of time*, and in the atmosphere of *freedom*, which becomes super-personal and which may survive the shock of death. To get our young generation interested in questions of this nature means the creation of new beings and of a new world.

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Modern Industries—V

Manufacturing Arsenic in Devon and Cornwall

By Edward Cahen, A.R.C.Sc., F.C.S.

The chief impression that strikes a visitor on seeing an arsenic works for the first time is the appearance of dilapidation and primitiveness which it presents. This is due in part to the surroundings, often the remains of earlier industries, partly to the primitive apparatus actually used and still found to be the best for the purpose. Secondly, the visitor invariably asks for what purpose all this arsenic is being manufactured, no doubt thinking of the minute quantities he has read about in the accounts of some poison trial. It is, in fact, rather startling to see this deadly white powder heaped up in front of the chambers when they are being cleared, or filling casks in the store.

Devon and Cornwall have long been famous, not only for their cream, but also for their white arsenic. So pure, indeed, is the latter—manufactured, be it remembered, by the ton—that it needs the utmost ingenuity of the chemist to detect any difference between it and the assay samples put up in small bottles and sold in London with the guarantee and analysis of such well-known firms as Kahlbaum and Merck.

Sources of Arsenic

The chief source of arsenic is an arsenical pyrites, a mineral of a silvery grey colour, locally known to the miners as mundic, but scientifically called mispickel. This is either mined specially for the purpose, or obtained from the dumps of older workings such as those of the copper and tin industries, where the arsenic was left in the detritus after the metals had been recovered.

These dumps form quite a lucrative source of arsenic, for the mundic, which is heavy, can easily be separated from the lighter material by washing with water. For this purpose a James table or similar contrivance is used; this consists of a large oblong grooved table, slightly inclined, on to which the finely crushed material to be washed is fed. Down one side of the table there is a series of small jets of water which wash the material down the table, which is kept gently "jigging" the whole time. The heavier mundic travels to the end of the table and falls off into a receptacle, the lighter particles passing away to one side.

Arsenic Burning

The mundic from either source is then taken to the arsenic works proper and fed into furnaces. The type

of furnace more commonly used is a rotatory furnace, the round hearth of which is kept gently rotating as the material is heated by means of a fire beneath. The mundic is fed in through a hopper at the top, and the arsenic burner is able to watch the process through a small door at the side. The strongly fuming mass is mechanically raked during the process, the ash or rinkle, as the workmen call it, falling off the edge of the furnace floor into the pit. The other furnace sometimes employed is of the ordinary reverberatory type, in which the flames actually play over the surface of the mundic which is "ravelled" from the side by a pole some eight or nine feet long, wielded by the furnacemen with great dexterity. Much depends upon the arsenic burners' skill in the management of the temperature and mundic in this type of furnace.

FIG. 1.—GENERAL VIEW OF AN ARSENIC WORKS.

FIG. 2.—A JAMES TABLE.

When once alight these furnaces are kept going day and night, Sundays and holidays, the men working in shifts of eight hours at a time, until it is judged that sufficient arsenic has collected in the chambers attached to the furnaces by a flue and designed for the deposition and retention of the arsenic vapours. The fire is then drawn or the gases are diverted, by means of a damper, to another "set," as a series of chambers is called.

The Refined "Soot"

The product of this first process is arsenic soot and is generally of a greyish colour, though it varies greatly from buff to black, according to the material burnt and type of furnace used.

Arsenic soot is also obtained from other industries in the neighbouring districts, coming, for instance, from the roasting of tin ores before the latter can be smelted. The larger smelters recover this by-product in large flues designed for this purpose. Arsenic soot varies greatly in the amount of white arsenic (As_2O_3) it contains, but in any case it is subjected to the refining process before it is placed on the market. The soot is removed from the chambers and returned to a similar furnace called a "refiner," where it is again heated and volatilised. Here, however, smokeless coal is used so that the arsenic may not be contaminated with particles of carbon from the smoke, and in the case where a round furnace is used it is not rotated and there is no raking apparatus. The fumes of oxide of arsenic pass up the flues to the chambers, where they condense in the form of a beautiful white crystalline powder on the floor, walls, and ceiling. The long flues and rows of chambers are quite a characteristic feature of an arsenic works and contribute to the appearance of dilapidation and antiquity which we have referred to, for the flues are outwardly quite roughly constructed of brick or the local stone, following the slope of the country-side for a considerable distance upwards to the stack, where the sulphur dioxide escapes into the atmosphere. The object of these long flues is to retain the last traces of arsenic, which would otherwise be detrimental to vegetation near the works. The flues are cleaned out about once a year and the arsenic profitably recovered.

FIG. 3.—CLEARING OUT THE ARSENIC SOOT.

The chambers where the soot or white arsenic is collected are small vaulted brick rooms connected one with another by an arched opening so placed that the gases, in their passage from one chamber to the next, strike a relatively cool wall before finding their way to the exit placed in the corner diagonally opposed. As the white arsenic vapours zigzag through these chambers, they condense and deposit in the form of fine white crystals. Along one side of a "set" lies a series of doors, which are closed with clay while the process is proceeding, and are afterwards opened in order to extract the arsenic. This, looking like so much snow, is simply shovelled out into trollies and taken off to the mill.

Grinding the Arsenic

The milling process is rendered necessary so as to ensure a uniform sample, for the arsenic deposited in the chambers nearest the furnace is much denser than that in those farthest away. The mills used consist of two granite stones, dressed on the works, one of which is superimposed on the other and slowly rotated by means of a steam-engine or water-wheel. The arsenic is fed in at the top and the finished product is collected in barrels underneath.

The mills activated by means of a water-wheel are particularly interesting from an antiquarian point of view, for there is just such a mill illustrated by means of a woodcut in Agricola's *De Re Metallica*, the first Latin edition of which appeared in 1556. This work was translated by H. C. and L. H. Hoover and published by *The Mining Magazine* in 1912.

The arsenic thus produced and sold by the ton is the white oxide, and is largely used in the manufacture of sheep dip, weed killer, and fruit sprays, to mention but three of its many uses. The arsenic from Devon and Cornwall is in constant demand on account of its uniform good quality, though it has to meet very severe competition from abroad, where it can be produced somewhat more cheaply than is possible in this country.

Much has been written about the dangers incurred by the workmen on an arsenic works, but this appears to be greatly exaggerated and, generally speaking, they are a fine, healthy set of men.

An Aztec Secret Society

By Lewis Spence

Author of "The Gods of Mexico"

THOSE very human and sympathetic apostles whom devout Spain shipped to pagan Mexico soon after its conquest by Hernando Cortes early in the sixteenth century quickly discovered that it was not so much a religion from which they had to wean the native mind as an elaborate ritual mingled with magical practice. The dusk of magic which shadowed the bizarre crowded cities could almost be felt by these brave priests. It was easy enough to combat an idolatry regarding the higher conception of which the people had only loose ideas and legendary glimmerings. But the more popular devil-worship which accompanied it had a far stronger hold on the native affections. The Aztec was enthralled by it ; his whole life from the cradle to the grave was ordered by its inevitable and ghastly provisions.

No sooner had the Mexican aristocracy been accounted for by slaughter or conversion than a significant change took place in the tendency and character of the native faith. The Aztec priesthood, realising that if its doctrines were to survive at all it must make a powerful appeal to the mass mind of the nation, threw every ounce of energy into the task of shaping the superstitions of the lower orders into a deadly instrument of vengeance against the whites. In this new movement magic of a repellent kind was joined with political conspiracy against Spanish supremacy, and the extraordinary cult thus developed came to be known as Nagualism, whose chief deity was Satan himself, if we are to credit the writings of those who opposed it and laboured untiringly for its destruction.

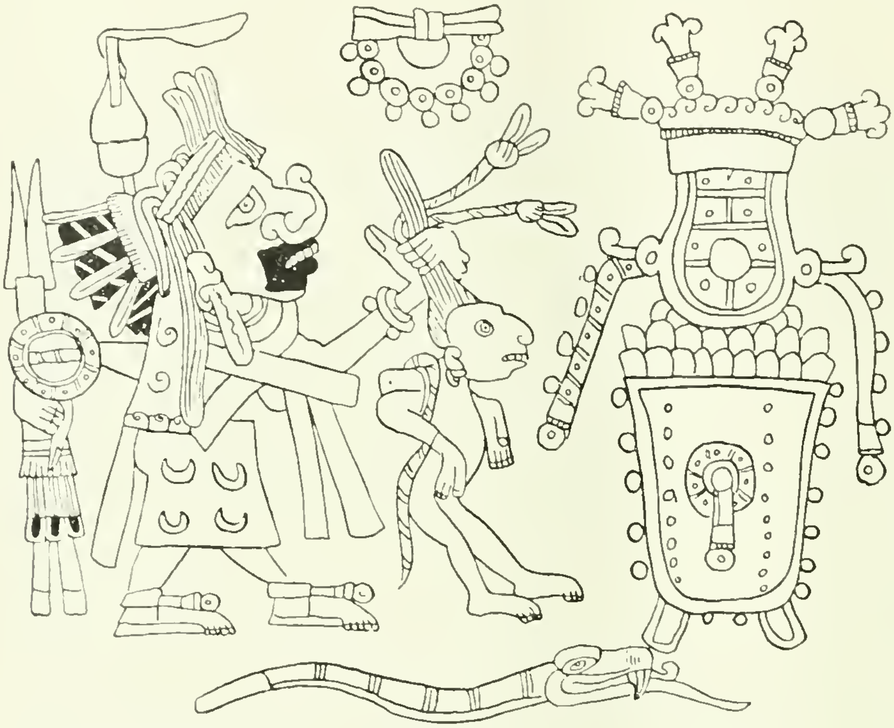
Local Brotherhoods

This mysterious secret society had branches in all parts of the country and its members were classed in varying degrees, initiation into which was granted only after prolonged and rigorous experience. Local brotherhoods or lodges were organised and there were certain recognised centres of the cult. At each of these places was stationed a high priest or master magician, who had beneath his authority often as many as a thousand lesser priests, and who exercised control over a large district. The priesthood of this diabolic guild was handed down from father to son. The highest grade appears to have been that of Xochimilca or "Flower-weaver," probably because its members possessed the faculty of deceiving the senses of votaries by strange and pleasant visions induced by potent drugs, as, for instance, the *peyotl*, a plant of the genus *Cocolia*, which resembles garlic. Like the *kava* of the Polynesians, it was first masticated and then placed in a wooden mortar, where it was left to ferment. Another plant employed by the Nagualists for the purpose of inducing ecstatic visions was the *ololiuhqui*, from the seeds of which a liniment was crushed and rubbed over the body after being mixed with the ashes of spiders, scorpions, and other noxious insects.

All Christian ceremonies celebrated by the friars were at once annulled by the Nagualist priesthood. If a child were baptised with the holy water, it was immediately carried to the cave or secret meeting-place of the Nagualists, where the rite was "reversed" by the aid of black magic. This was effected by endowing the child with a nagual or animal guardian, a totem [1] protector, which was regarded as its spiritual guide and mentor, to whom in all the difficulties and perplexities of life it must turn for advice and instruction. These animal guardians were selected according to the dates against which their pictures appeared in the

[1] A totem is the natural object, such as an animal, taken by primitive and semi-primitive peoples as the emblem of their clan or fellowship.

native calendar. For example, in the Xagualist calendar for January, the first day of the month was represented by a puma, the second by a snake, the eighth by a rabbit, the fourteenth by a toad, the nineteenth by a jaguar, and so on. The animal of the day was invoked by the priest, who offered up sacrifice to it, implored its good offices for the child, and then instructed the infant's mother to carry it to a certain lonely spot, where the nagual would appear and become attached to it for the remainder of its life. of a particularly vindictive and disgruntled nature. Strangely enough, the same notion is to be met with in present-day Burma, where the spirit of the woman who leaves a new-born babe behind her is regarded as a peculiarly malevolent ghost. These witches are represented in the native paintings as dressed in the garments and insignia of the goddess Tlazolteotl, the Mexican patroness of witches. They wore a skirt on which cross-bones were woven, they carried the witch's broom of stiff grass, and their faces were smothered in white chalk decorated with the figure of a butterfly, the emblem of the disembodied soul.



ONE OF THE CIUATETEÔ, OR MEXICAN WITCHES, FROM THE CODEX BORGIA.
She is about to sacrifice a child, and stands before an urn filled with human hearts. She wears the cotton spindle of the earth-goddess, her skirt is decorated with lunar emblems and she is adorned by the lunar nose-plate.

The "Haunting Mothers"

Many of the worshippers of these beast-gods pretended to have the power of transforming themselves into the bodily shapes of their patrons, just as the witches of mediæval Europe claimed the ability to take animal shape. It is indeed strange how closely the rites of Nagualism resembled those of the European witches' Sabbath. But it seems to have been an orgy in which the living and the dead mingled, for it was attended not only by those women who dabbled in unholy rites, but by the great company of those deceased women who had in their day practised black magic. Those were known as Ciuateteô, or "Haunting Mothers." Some of them were merely unhappy mothers who had died leaving young children behind them, and who for this reason were supposed to be

These furies were supposed to inhabit the region of the west. At midnight they descended to earth and mingled with the living witches in horrid festival. The Aztecs believed that many complaints, particularly epilepsy, were sown broadcast by these strigæ, and so that no evil emanations might enter their houses, they stopped up the chinks in the doors and windows, and even the chimneys, on certain nights of the year which were peculiarly associated with the dead witches.

A picture of their queen and patroness in the Codex Fejérváry-Mayer in the Free Public Museums at Liverpool bears an extraordinary resemblance to the European witch of tradition. She is represented as

nude, wearing a high peaked hat, and is seen taking her flight through the air on a broomstick. In other pictures she is seen standing beside a house, accompanied by an owl, the whole representing the witch's dwelling, with medicinal herbs drying beneath the eaves. Thus the evidence that the Haunting Mothers and their patroness present an exact parallel with the witches of Europe seems pretty complete, and should provide those who regard witchcraft as a thing essentially European with considerable food for thought. The Nagualists smeared themselves with a magical ointment by virtue of which they believed they could fly through the air, and engaged in wild and intemperate dances precisely as did the adherents of Vaudérie in France, or the witches of England; they met at cross-roads, where they danced to pipe and tabor, and they brewed strange potions, love-philtres, and poisons quite in the manner of the Lancashire or Devonshire hags.

Magic Arts of all Kinds

But shape-shifting and witchcraft were not the only magical resources of the Nagualists. Their arts were manifold. They could render themselves invisible and walk unseen among their enemies! They could transport themselves to distant places, and returning, report what they had witnessed! Like the fakirs of India, they could create before the eyes of the spectator rivers, trees, houses, animals, and other objects. They would, to all appearance, rip themselves open, cut a limb from the body of another person and replace it, and pierce themselves with knives without bleeding. They could handle venomous serpents without being bitten, as can their representatives among the Zuñi Indians of Arizona to-day, cause mysterious sounds in the air, hypnotise both men and animals, and invoke spirits who would instantly appear. Of these things the credulous missionary friars believed them fully capable. What wonder, then, that they were regarded by the natives with a mixture of terror and respect?

The esoteric details of the secret ceremonies and doctrines of Nagualism have never been fully revealed, and it is only from scattered passages in the writings of the Spanish missionary friars that we can throw any light on this mysterious secret society. When the Austrian traveller Dr. Scherzer visited Guatemala in 1854, he found Nagualism in full force in the more remote districts, where there is good reason to believe it still flourishes.

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An Imperial Airship Service

By Major W. T. Blake

COMMANDER BURNEY first placed his scheme for an Imperial Airship Service before the Government about two years ago, but since then it has undergone various modifications, until the idea has been accepted in principle by the Government, and negotiations are now taking place between Commander Burney and the Treasury with regard to financial matters. If these are settled satisfactorily, as it is anticipated that they will be, it should be possible to have the first airship in commission in 1925.

In laying his scheme before the Air Conference in February this year, Commander Burney stated that three principal benefits would accrue from the successful establishment of an Imperial Airship Service. These were the imperial and political advantages accruing from a safe and cheap form of transport; the value in war-time of a fleet of airships together with fuelling bases all over the world; and the value of a commercial company with British capital operating a service on a profit-making basis.

Briefly, the scheme is for the inauguration of an airship service from England to Egypt, India, Singapore, and Australia. At first only the Egyptian route will be worked, this being extended to India when more ships are available, and later to Australia, the full service of two airships each way between England and India and one between England and Australia per week being reached about 1927.

Subsidies by the Government

In order to build these vessels a capital of £4,000,000 was originally suggested, so that six ships could be built, sheds and mooring masts erected, and fuelling depots and mooring bases constructed at Port Said, Bombay, Rangoon, Singapore, and Perth (Australia). The whole of the organisation was to be at the disposal of the Admiralty in time of war, and in return for this the Government was asked to guarantee the debentures as to principal and interest, and the ordinary shares as to dividends only, for ten years at the rate of 6 per cent.

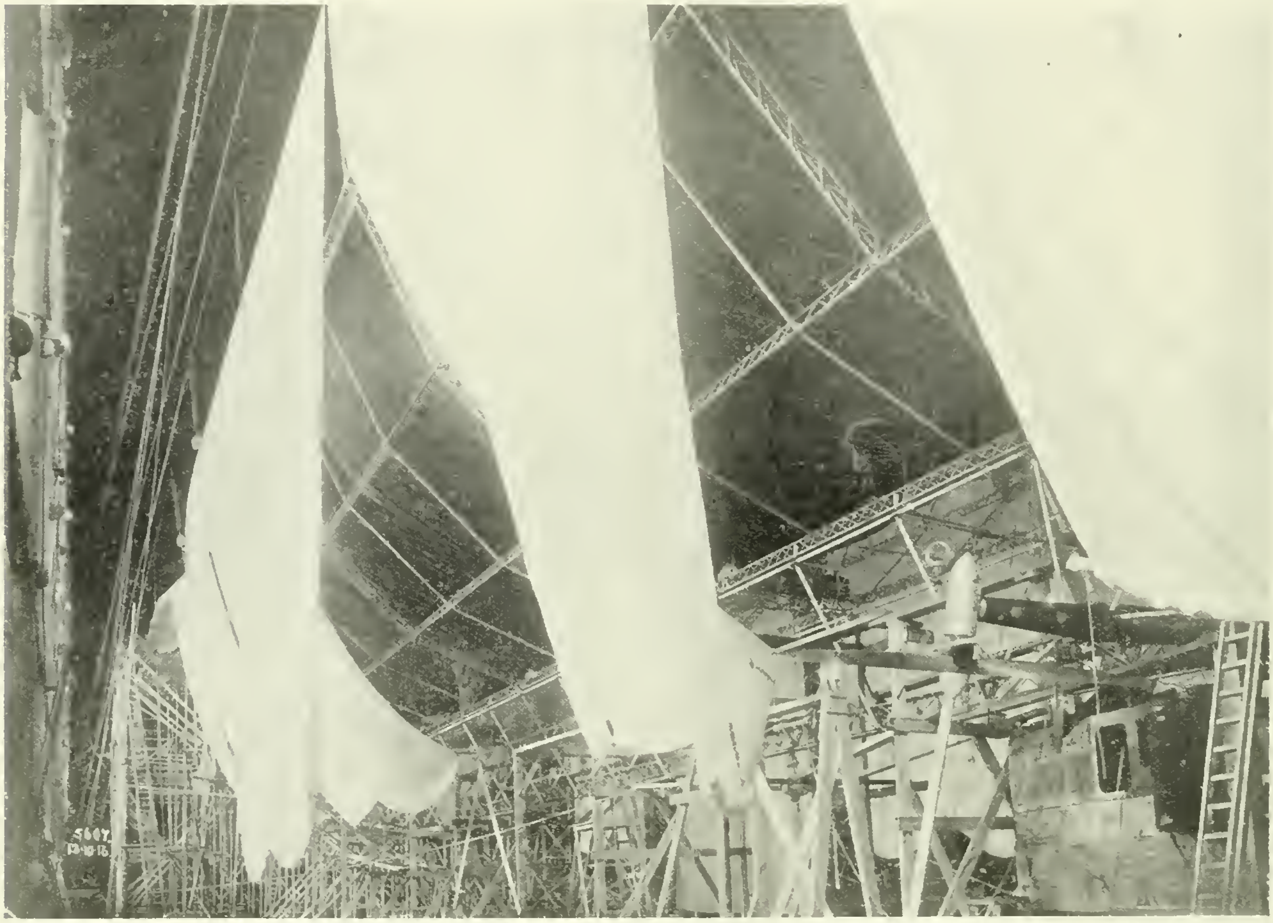
The scheme was rapidly taken up by influential bodies, Messrs. Vickers Limited and Shell-Mex Limited being the principal financial backers. After considerable delay the proposition has been accepted by the Government, but in the interval since the first proposal the financial estimates have undergone considerable

modification, and it is with the modified scheme that the Treasury is at present concerned. The technical side has not been altered except to curtail it somewhat in accordance with the reduced financial commitments.

The present proposals are that the promoters, on signing the agreement with the Government, are to form a guarantee company with a capital of £600,000, which company would undertake to form an airship company of £400,000 capital (£200,000 paid up), the Government to pay to this company on incorporation £400,000 as the first year's subsidy. The company would then erect the necessary mooring masts and plant, and build one airship of 5,000,000 cubic feet capacity in order to test the route to India.

Subject to this airship passing its trials and carrying out a flight to India in less than 100 hours' time, the subsidy at the rate of £400,000 a year would become payable for a further three years, and the company would increase its capital from £400,000 to £1,700,000. If, before the expiration of the third year, the company has been able to run a weekly service to India for at least three months prior to the date of the renewal of the subsidy, the Government would agree to pay three further subsidies of £400,000 a year, the capital of the company meanwhile being increased from £1,700,000 to £3,000,000, the service being extended as necessary, until the full twice-weekly service to India and once-weekly to Australia had been inaugurated.

At the end of this time the subsidy, which had been paid at the rate of £400,000 a year for seven years (a total of £2,800,000), would become repayable to the Government, half the profits above 10 per cent. earned by the company being paid to the Treasury, until the full £2,800,000 had been paid off.



VIEW SHOWING METHOD OF CONSTRUCTING THE HULL OF A RIGID AIRSHIP.

The girders and bracing wires are in position, the gas bags have been installed and the outer envelope is about to be placed in position.

Airships with Gas-bags of Ten Acres

The vessels to be employed on the service will be of 5,000,000 cubic feet capacity, and will in all probability be built by Vickers Limited, who constructed four of our fourteen rigid airships during the war.

Such vessels will be approximately 760 feet in length and 110 feet in diameter. They will have an air displacement of 150 tons and a speed of 80 m.p.h., and will be able to carry 200 passengers and 11 tons of mails and freight on a non-stop flight of 2,500 miles, which would amply cover the distances from England to Egypt and Egypt to India. Carrying no cargo, this type of ship would have a range of 11,500 miles at 80 m.p.h., or 24,000 miles at 40 m.p.h. Each ship will have six engine units, of which two will probably be held in reserve. The area of fabric for gas-bags for each ship is 40,400 square metres, which is about 10 acres.

A possible new feature may be the introduction of hydrogen-burning, in addition to liquid fuel for the engines. It must be realised that, as the airship consumes liquid fuel and the gross weight therefore decreases, some of the hydrogen which fills the gas-bags has to be released in order to keep the airship at the proper level. It is suggested that it may be possible to burn this waste hydrogen in place of the liquid fuel in the engines, and experiments are now being carried out in this direction. Had the R34 been fitted for hydrogen-burning on her Atlantic flight, instead of landing at New York with barely 100 gallons of fuel left, she would have had nearly 1,000 gallons surplus, or sufficient to have carried her another thousand miles. Hydrogen-burning would enable the commercial load of a 5,000,000 cubic foot airship to be increased by 13 tons on a flight from England to Egypt.

In any case the new airships will probably not be fitted for using petrol, as this is considered the greatest danger to which modern airships could be subjected. Possibly kerosene will be used, though a heavier oil may eventually be substituted.

This will also have the effect of reducing fuel costs to about one-seventh of the present costs incurred when using petrol. Another factor is the increased number of hours an engine can be run without an overhaul, the increase being approximately from three hundred to eight hundred hours.

The estimated cost of building a 5,000,000 cubic foot capacity airship works out at about £150,000.

Mooring Masts Fitted with Lifts

Along the route to Australia will be two types of bases, one being a shed or docking base, and the other a mooring-mast base. For normal purposes a mooring mast is the simplest and most efficient method of anchoring aircraft. The ship can be brought to rest far more simply at a mast or tower than in a hangar, and can be released still more expeditiously. Passengers will enter the ship by means of lifts operated inside the tower to the top of which the nose of the airship is fastened. They will then enter the vessel along a covered gangway. Fuel and stores can also be taken up through the tower.

The estimated cost of these bases is £300,000 each in the case of the shed or docking base, which would also be fitted with mooring masts, gas plant, etc., and £100,000 for a mooring-mast base only. The masts themselves are estimated to cost about £20,000 each with equipment, whilst the sheds would cost £150,000 each, or approximately as much as an airship itself.

With regard to the financial return which might be expected on the route when the service is operating fully, the capacity of the ships would be 400 first-class and 400 second-class passengers per week, i.e. 100 first-class and 100 second-class on each voyage in each direction. In addition about 44 tons of mails and baggage could be carried. If the passenger freight is assumed to be 50 per cent. of the full load, and mails and baggage 70 per cent. of the full load—not an outside estimate—and first-class fares from London to India cost £70, second-class £45, mails 2½*d.* per oz. and parcels 1s. per lb., the total receipts per year would be £1,827,480. Running expenses for six ships, crews, gas, material, and depreciation, in fact all expenses, would be about £880,750 per annum, so that with a 50 per cent. load a profit of about £1,000,000 a year on the total capital of £3,000,000 would be made. Even if only 25 per cent. loads were carried, there would still be a small profit.

The final consideration is whether passengers would be tempted to travel by airship. In this connection the following comparison of existing times of transit, and times of transit by the future airship service are of interest :

—			Present Day.	Airship.	Saving.	
			days.	days.	days.	%
England	to	Egypt	6	2½	3½	= 58
,,	,,	Bombay	15	5	10	= 66
,,	,,	Rangoon	19	7	12	= 64
,,	,,	Singapore	24	8	16	= 67
,,	,,	Perth (W.A.)	28	11	17	= 61
Egypt	,,	Bombay	9	2½	6½	= 72
,,	,,	Rangoon	13	4½	8½	= 65
,,	,,	Singapore	18	5½	12½	= 69
,,	,,	Perth (W.A.)	22	8½	13½	= 61
Bombay	,,	Rangoon	4	2	2	= 50
,,	,,	Singapore	9	3	6	= 67
,,	,,	Perth (W.A.)	13	6	7	= 54
Rangoon	,,	Singapore	5	1	4	= 80
,,	,,	Perth (W.A.)	22	4	18	= 82
Singapore	,,	Perth (W.A.)	17	3	14	= 82

Average saving = 66 per cent.

When to this saving is added the fact that the proposed airship fares are considerably lower than the present liner fares, and that the comfort and safety of travel by airship will be at least equal to that experienced at sea, there appears very little doubt

that there will be a sufficient number of passengers to be carried. And, as a minor consideration for the Empire, this great airship trunk route will call up hundreds of aeroplane routes connecting with the airship bases, so that the formation of the airship routes should greatly benefit the whole flying world.

Three Forgotten Phrygian Martyrs

By W. M. Calder

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An Early Christian City

The city of Laodicea Combusta ("Laodicea the Burnt"), so called from the charred volcanic hills which form the most striking feature in its landscape, lay thirty miles north-west of Iconium. That portion of Phrygia formed part of the Roman province Galatia till A.D. 295, and was then incorporated in the province Pisidia. This district was the "Phrygian region" of the Acts of the Apostles, and it was evangelised from the Churches founded by the Apostle Paul in its two chief cities, Antioch and Iconium. For the first three centuries of our era, the history of this Laodicea (which must be distinguished from the "lukewarm" city on the Lycus, whose name has become proverbial as the description of a comfortable and complacent Christianity) is practically a blank. The name hardly appears in literature, and Laodicean inscriptions and coins belonging to these centuries are few. But fourth-century Laodicea has provided the epigraphist, and especially the Christian epigraphist, with an unusually fruitful field of study. In 1888 Ramsay published a collection of early Christian inscriptions from Laodicea (a few of them already published by Hamilton) which, if we except the epitaph of a deacon who held the heresy known as Novatian, presented no exceptional feature. A second Novatian epitaph (heretical epitaphs are exceedingly scarce in the early centuries) was copied by the Austrian explorers Heberdey and Wilhelm as they rode through Laodicea on their return from Cilicia, and published in 1896. Apart from these journeys, the site of Laodicea and its environs were practically neglected until the years 1904–1913, when several visits were paid to them by Ramsay, Callander, and the writer. These visits, year by year, yielded an epigraphical harvest of peculiar interest, and mark Laodicea as a site which will repay further investigation. Some of the results have been published; others are in course of publication. On the present occasion I will describe the epitaph of a Laodicean martyr, now for the first time identified as such, and will refer in passing to two other martyrs of whom the inscriptions of Laodicea have preserved a record. This will throw some light on the character of the Great Persecution as it affected Phrygia. The new martyr's epitaph was discussed in a paper read before the Byzantine section of the *Congrès International des Sciences Historiques* at Brussels in April 1923; it is here described, in complete form, for the first time in print.

Two Laodicean Martyrs

The epitaph of Julius Eugenius, Bishop of Laodicea Combusta from about A.D. 315 to about A.D. 340 or later, was discovered in 1908, and has taken rank as one of the most important of early Christian inscriptions. Its reference to a forgotten decree of the Emperor Maximinus II, ordering that Christians in the Roman service should be compelled to sacrifice to the statues of the Emperors without the option of resigning their posts, makes it an historical document of major interest; and it is the only early Christian inscription so far found in the "Phrygian region" which can be accurately dated. It thus forms the pivot of a chronological arrangement of the documents of this region. Eugenius tells us that he had suffered in the persecution of Maximinus II, while Valerius Diogenes was governor of Pisidia; that a short time afterwards he had been made Bishop of Laodicea, and that he had been Bishop for twenty-five years when he prepared his tomb. These details enable us to fix the commencement of his episcopate and the preparation of his last resting-place within a year or two of the dates given above. When he became Bishop of Laodicea, his principal concern was to "rebuild the church from its foundations"; and this statement throws a welcome but by no means unexpected light on the character of the persecution at Laodicea. A further glimpse of the sufferings of the Laodicean Christians was afforded by the discovery, in 1911, of a second inscription referring to the same Eugenius. This is the dedication, in five elegant elegiac couplets, four of which have been preserved, of a *martyrion* or memorial chapel which was erected by the Laodicean Christians, towards the close of the fourth century, to hold the relics of Eugenius and his martyred predecessor Bishop Severus. In this inscription—which, incidentally, informs us that the Laodicean community belonged to the sect of the Saccophori, a sect of teetotalers who used only water in the Eucharist—Severus is described as "the glorious victor in the contest of the Heavenly Father." Such language, at this period, could only be used of a martyr. Eugenius tells us in his epitaph that he had suffered many tortures in the persecution; the natural inference

from the building of a memorial chapel to the two bishops is that Severus had been put to death. This conclusion is, however, not absolutely certain, as the title of "martyr" was given to those who remained steadfast under torture, even if, like Eugenius, they survived.

Martyrs' Epitaphs very Rare

While the names of martyrs and details of memorial *martyria* abound in Christian inscriptions of the Byzantine period, it is well known that contemporary inscriptional records of martyrdom are exceedingly scarce. So far, apart from Laodicea Combusta, only three such inscriptions have been found in Asia Minor. Two of these are epitaphs, to be carefully distinguished from memorial dedications on *martyria* in which the relics of martyrs were deposited some time after their death. The first, which has long been known, but whose meaning was first pointed out by Ramsay, is the dedication by a bishop or presbyter in the Phrygian Pentapolis of a tomb to his "five children," of whom it is said that they "won the portion of life in one day." The language of this inscription suggests that these were spiritual "children," and most (but not all) good authorities agree in regarding them as martyrs. Their names, given in the epitaph, are unknown to the martyrologies. The second is the epitaph—from its expression it can be nothing but an epitaph—of a martyr Paul found at Derbe, which runs as follows: "Nounnos and Valerius built the tomb of Paul the Martyr in remembrance." Miss A. M. Ramsay, who published a drawing of the monument, has been followed by M. Grégoire in distinguishing this inscription from the later class of memorial dedications, and regarding it as the inscription of a tombstone set up over the grave of a martyr. This conclusion appears to me inevitable; I regard this Paul as a martyr who suffered in the Great Persecution, and had a gravestone erected to him immediately after the act of Constantine legalising Christianity. The open use of the term "martyr" on a tombstone could hardly have been tolerated by the officials of the Roman government during the persecution itself; the stone dates after the Act of Toleration (A.D. 312) or even after the final defeat of Licinius in A.D. 323.

The Romans and Kitchener of Khartoum

In the *Martyrdom of Polycarp*, the letter sent by the Church of Smyrna to the Church of Philomelium in or soon after A.D. 155 describing the passion of their bishop, we have evidence that, as early as the middle of the second century, the Roman government had adopted the policy of withholding the remains of martyrs (at any rate in Asia Minor) from their fellow Christians. St. Augustine, at a later date, was at pains to explain that the cult of the martyrs had nothing in common with pagan worship of the dead. But in Asia Minor the worship of the dead was a central feature of the popular pagan religion, and the Romans, in the second and third centuries, had as clear a motive for objecting to the erection of Christian *martyria* as Lord Kitchener had for destroying the tomb of a Sudanese Mahdi. This Roman policy no doubt explains the scarcity of identifiable martyrs' tombs; it also throws light on the circumstances under which relics of the martyr Trophimus of Pisidian Antioch, who suffered under the Emperor Probus (A.D. 276–282) were deposited in a reliquary coffer dug up near Synnada in 1907, and now in the Museum at Brussa. On the lid of this little marble box, shaped like a sarcophagus, is carved the legend: "Within are bones of Trophimus the Martyr. And whosoever shall ever cast out these bones, he shall have to reckon with God." It is obvious that this coffer was not intended for open exhibition; but it is inscribed with the very formula by which the early Christians of Phrygia, throughout the later third century, warned wrongdoers against interference with the graves of their dead. This formula, "he shall have to reckon with God"—or, as pagans read it, "with the god"—is exclusively Christian, and was in use by the Christians of Central Phrygia during the third century. The lettering of the inscription points to the same date, and the coffer, as Mendel (the first editor), Grégoire, and Ramsay have maintained against the late M. Duchesne, certainly belongs to the period of persecution, and is contemporary, or nearly contemporary, with the death of Trophimus. Trophimus is mentioned in the martyrologies, where the place of his martyrdom is given as Synnada. The dedication of a public tomb to a martyr was precarious; probably the fortunate discovery at Synnada illustrates a practice common during the persecutions, in spite of Roman vigilance.

A Third Laodicean Martyr

These considerations explain the curiously noncommittal character of the following dedication of a martyr's tomb from the neighbourhood of Laodicea. It belongs to Suverek, which occupies the site of an ancient village (probably on the territory of Laodicea) which was raised to the rank of a bishopric (Psibela) at a later period. It was copied by Callander in 1904 and by Ramsay in 1906, in both cases without a complete version of the important third line. In 1910 I succeeded in reading this line completely; my copy was confirmed by Ramsay, and rests on our joint evidence.

The syntax of the inscription is irregular, and some

details are uncertain, but the general sense, which I translate as follows, is clear.[1]

> The tomb of Gennadius his father and lady mother
> constructed, for he grieved his family and native town,
> being a pastor over the sheep ; for he endured (the prediction of) Holy Writ,
> dying most piteously, and among impious foes
> being gentle, and in years short-lived he came to his end.[2]

This is an epitaph—at first sight of an ordinary pagan type, belonging to the late third or early fourth century, and using the jerky and broken-winded hexameters common in this class of epitaph—dedicated to Gennadius by his unnamed father and mother. But when we look closely into it, we find features which distinguish it sharply from pagan epitaphs. The word " impious," applied to the " enemies " among whom Gennadius was so " gentle," reminds us at once of the language of the *Acts of the Martyrs*, in which similar expressions occur over and over again. This would of itself suggest that Gennadius was a Christian martyr ; the third line, now fully recovered, places the question beyond doubt. In this line, " pastor over the sheep " describes the office of Gennadius in words which were consecrated in this sense from the first beginnings of Christianity, and the obscurely compendious " he endured Holy Writ," whatever the exact meaning we attach to the words, describes the conduct of a martyr who was steadfast to the end. The close association, in the Greek original, between these words and " dying most piteously " in the next line makes it clear that they refer to the martyrdom of Gennadius. They may mean either " He (did not deny) Holy Scripture, but endured (death) " or, more probably, as I have translated them, they are a condensed way of saying, " he endured the prediction of Holy Writ," in which case this south Galatian epitaph would contain a clear reference to the words addressed by Paul to the south Galatians in Acts xiv. 22, " exhorting them to continue in the faith, and that through many tribulations we must enter into the Kingdom of God," and to the south Galatian Timothy (2 Tim. iii. 12) : " Yea, and all that would live godly in Christ Jesus shall suffer persecution." Such obscurity of expression is familiar to students of the epigraphy of pre-Constantinian Christianity. During the centuries before Christianity became a legal religion, the Christians had perforce to avoid open profession of their religion on tombstones, and had recourse to a veiled language. This obscurity of expression was both deliberate and necessary.

As regards the date of this inscription, I can feel no doubt that it belongs to the persecution under Maximinus II, which, as we have seen, weighed heavily on the Christians of Laodicea. The design of the panel, and the lettering, are similar to those on the sarcophagus of Julius Eugenius, although in this village epitaph the execution is not so careful. The sarcophagus of Eugenius was prepared about A.D. 340 ; the tombstone of Gennadius was dedicated a decade or two earlier, during the persecution or immediately after it. That it was contemporary with the persecution is clear from its veiled language ; in the inscriptions of Eugenius and Severus, carved after the peace of the Church, Christianity is openly proclaimed. In the fourth century the ancient settlement at Suverek was probably a village on the territory of Laodicea ; its inscriptions betray no trace of a separate city organisation. Gennadius was accordingly a presbyter, or at most a village bishop (*chor-episcopus*) under Bishop Severus of Laodicea. Eugenius survived his torture ; Severus probably, and Gennadius certainly, " won the victor's crown." The Laodicean inscriptions thus remind the Church of three forgotten martyrs.

The Great Persecution in Phrygia

Neander, arguing from literary sources, and Ramsay, using the evidence of inscriptions, have both drawn the conclusion that Phrygia suffered but slightly in the persecutions antecedent to the great massacres under Decius and especially Diocletian and his associates (including the fierce persecutor Maximinus II, referred to by Bishop Eugenius). In the second and early third centuries persecution was usually instigated, and at times forced on an unwilling government, by the pagan population—or by the Jews ; under Decius and Diocletian, it was engineered by the government itself. The picture of Phrygian society which the inscriptions enable us to reconstruct explains both the comparative lightness of persecution in the earlier period, and its severity in the later.

It is a picture, as Ramsay has pointed out, of accommodation and good feeling between the Christians and their pagan neighbours. On the negative side the orthodox Christians (I say " orthodox " because some of the heretical bodies form an exception) avoided all parade of their religion which would give offence to pagan susceptibility ; on the positive side, they appear to have played an influential and patriotic part in the city life of the province. Under these conditions, the chief motive of the earlier type of persecution, popular ill-feeling against a body of men who were regarded in

[1] M. H. Grégoire, who very kindly read the paper referred to above at the Brussels Congress in my absence, differs from me in one or two points of detail, but accepts as certain my interpretation of this inscription as a martyr's epitaph.

[2] Τύμβον Γενναδείου πατὴρ καὶ πότνια μήτηρ
ἐξετέλεσσαν· ὁ γὰρ γένος πάτρην τ᾽ἀκάχησεν
ποιμέν᾽ ὄντ᾽ ἐπ᾽ ὄεσσιν· ὁ ἱρο[γ]ραφείην γὰρ ἀνέτλη
οἴκτιστον θνήσκων, καὶ δυσμένεων ἀνοσείων
ἤπιος ὤν, ἐταίων μινυνθάδειος δ᾽ ἐτελεύτα.

The accusation at the beginning of l. 3 depends on the verb " adorned " or " buried," implied in the first sentence.

the Roman Empire generally as anti-social and unpatriotic, was largely absent in Phrygia; under these conditions, we can understand why the later type of persecution fell with especial fury on the Phrygian cities. Diocletian's policy was war on the Church as such; and good strategy demanded that he should attack the enemy in his strongest positions. It is clear that by the end of the third century many parts of Phrygia were almost solidly orthodox. Hence the severity of the Great Persecution in this area.

The Anti-Christian Associations

These are considerations of a general character. But there were special conditions in Phrygia, and especially in the rural districts of eastern Phrygia, which accentuated the severity of the persecution. In this area most of the land was in the private possession of the Roman Emperors, and the *coloni* or farmers on the Imperial Estates were united in associations whose bond of union was the worship of the God-Emperor. When the Emperor happened to be a Diocletian or a Maximinus, these associations lay ready to his hand as an instrument of persecution. Ramsay has in fact shown, on the evidence of the inscriptions of the Tekmoreian Brotherhood of the Estates near Pisidian Antioch, that there was an artificial and official revival of pagan worship on these Estates in the later third century, and has connected this revival with the anti-Christian propaganda organised by the Roman government. These Estates had, it seems, succeeded to the function of the Jewish synagogues of the second century, and had become, if not the sources, at least the media, of persecution. The Estates represented in the subscription-lists of the Tekmoreian Brotherhood at Antioch covered most of eastern Phrygia, and in the activity of this widespread and highly organised anti-Christian association we have doubtless a contributory cause of the severity of the persecution in this region. It is perhaps not without significance that Laodicea Combusta was itself close to an Imperial Estate, and inscriptions show that the bureau from which the Estate was managed was located in the city.

Montanism in the Persecution

A further consideration which must be borne in mind is the strength in Phrygia of a type of Christianity which actually courted persecution; and we may hazard the guess that many of the martyrs, both of the earlier and of the later period, represented this type. Phrygia was the home of Montanism; and an argument now in the press [1] will make it clear, I hope, that the peculiar north Phrygian tombstones, on which Christianity is openly professed, belonged to a Montanist community. The Montanists, as readers of Tertullian will remember, insisted on open profession of Christianity even at the risk of martyrdom. The argument that the north Phrygian "Christians to Christians" epitaphs are Montanist is reinforced by evidence from Lydia. Epiphanius, our principal authority on the early heresies, informs us that soon after the middle of the third century the Church of Thyatira was entirely Montanist, and a recently discovered third-century inscription from the neighbourhood of Thyatira makes open profession of Christianity. The inscriptions show that Laodicea Combusta was deeply affected by sectarianism in the later fourth century, chiefly of the Montanist-Novatian type; to this city belongs the unique distinction of having furnished a set of late fourth-century epitaphs mentioning Novatians, Cathari, Apotactites, Encratites, and Saccophori, the very sectarians regarding whose admission to the Church Amphilochius of Iconium consulted the great Basil of Cæsarea in A.D. 374. Epiphanius, writing in the same year, mentions a place which he calls "Phrygia the Burnt" as a nest of heresies and a centre of the Pisidian Encratites. The place he refers to, as I hope soon to prove elsewhere, is Laodicea the Burnt.

The Novatians and Encratites shared with the Montanists a stern attitude to those who "lapsed" in the persecutions, and communities of these sectarians must have presented a specially tempting target to the organisers of persecution.

The Fate of the "New Jerusalem"

I will close with a speculation. Eusebius and Lactantius both refer to a Christian town in Phrygia—neither gives its name—which was destroyed, with its whole population, in the Great Persecution. Eusebius adds the poignant detail that these Christians perished in the flames, "calling upon the God who is over all." Ramsay has published an ingenious argument identifying this town with Eumeneia or with Attanassus, whose inscriptions give evidence of a thriving Christianity throughout the third century, and suddenly cease at the end of it. But this is true (in a less marked degree) of other Phrygian towns. Moreover, Eumeneia and Attanassus were orthodox towns, and if an orthodox city had distinguished itself in this manner in the Great Persecution, it is unlikely that Eusebius at least would have withheld its name. The silence of Eusebius on this point, combined with the details which he gives of this frightful massacre, appear to me to point to a community of Montanist fanatics; and I would point out that Pepouza, in which a section of the Montanists awaited the Great Persecution and Descent of the New Jerusalem foretold in the Apocalypse, has in fact disappeared without leaving

[1] *Bulletin of the John Rylands Library, Manchester*, July 1923.

a trace. Can this be the true explanation of Epiphanius' reference to Pepouza : " The Montanists honour a deserted place in Phrygia, formerly a city called Pepouza, *but now levelled with the ground*, and they assert that the New Jerusalem descends there " ? The heretic Aëtius, we know, was banished to Pepouza (if that is the correct form of " Petonsa " which we read in the text of Philostorgius) in A.D. 356, and it has been argued that this disproves the statement of Epiphanius. But may we not rather enjoy the grim humour displayed in the choice of a place of exile ? The interesting detail recorded by Eusebius, that the Christians of the Phrygian town died " calling upon the God who is over all," is to be explained by reference to the prophecy of Joel, quoted in Acts ii. 17–21, " And it shall be in the last days . . . blood and fire and vapour of smoke . . . and it shall be, that *whosoever shall call on the name of the Lord* shall be saved." Such a reference suits the Montanists, whose faith was founded on the literalness of the prophecy in the Apocalypse, which foretold that a Great Persecution would precede the Second Advent. Neither Eusebius nor Epiphanius had any sympathy either with Montanism or with scientific history ; between the lines of their narratives I am inclined to read the fate which befel the New Jerusalem of the Montanists in the Great Persecution.

Can a similar faith and a similar prejudice be invoked to explain why the Christain martyrs who are gradually being restored to History by the inscriptions of eastern Phrygia are unknown to the Calendar of the Church ?

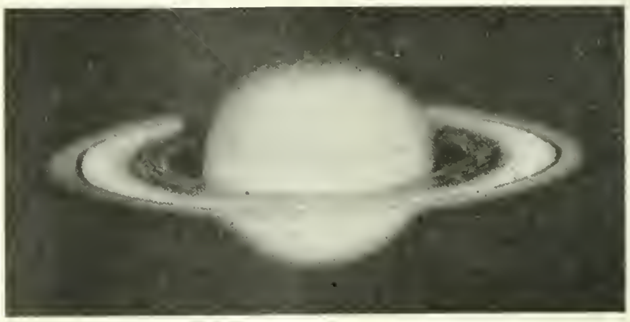
Among the Stars

A Monthly Commentary

The Giant Planets : A New Theory of their Constitution

As is well known even to those who have only a superficial knowledge of astronomy, the primary planets of the Solar System—exclusive of the asteroids—are divided into two groups which differ widely from each other. The four inner or dwarf planets are small, dense, mature bodies, while the four outer or giant planets are of great volume but comparatively small density. For the last half-century, indeed since Zöllner and Proctor showed that the clouds on Jupiter were in all probability raised by the intense internal heat of the planet, the opinion has prevailed that Jupiter, Saturn, Uranus, and Neptune are great inflated masses, partly gaseous, with very high internal temperatures. Despite much that is obscure and mysterious in regard to the giant planets, this view has been widely accepted, and has been on the whole satisfactory in explaining the markings both on Jupiter and Saturn. In a recent paper, however, Dr. Harold Jeffreys, who has made a special study of problems of cosmogony, challenges the prevailing theory and puts forward an alternative hypothesis. " The data," he states, " are more easily reconcilable with the hypothesis that these planets are cold and solid, their material being of low density in comparison with terrestrial rocks."

Dr. Jeffreys agrees with most astronomers in maintaining that in the case of each of the four outer planets, what we see is not the surface of a solid globe. This is proved by the fact that these planets do not rotate as rigid bodies ; the rotation period is dependent on the latitude. What we actually observe is a cloud layer in the atmosphere at a height corresponding to that of terrestrial cumulus and strato-cumulus clouds. Nor does Dr. Jeffreys deny that the densities of the outer planets are very low. He joins issue with the accepted explanation of these facts—namely, that the planets are largely gaseous and intensely hot. " The low density affords as good an argument for the hypothesis that these planets are solid as against it. It compels us, however, to suppose that these planets are all composed of matter very different from the chief constituents of the Earth."



THE PLANET SATURN AND ITS RINGS.

Here Dr. Jeffreys invokes the tidal theory of the origin of the Solar System, suggested by Dr. Jeans and developed by himself. On this theory the giant planets would keep most of their lighter material, while the dwarf planets would only retain their heavier matter. Accordingly, Dr. Jeffreys maintains that the giant planets are composed of something less dense than terrestrial rocks, and he finds confirmation of this in the low density of the satellites of Jupiter and Saturn. " The high albedo of Saturn's ring suggests that it is composed of some colourless substance in a state of fine division, possibly ice or some other light non-metallic compound.

Dr. Jeffreys agrees that the atmospheres are very extensive, the depth being one-fifth of the radii of the planets. These atmospheres must be cold, and the suspended clouds in them " are probably composed of some material with much lower boiling and melting points than water." The hypothesis is a revolutionary one, and will probably meet with considerable opposition. It will undoubtedly have the effect of quickening interest in the giant planets and their nature.

The Nature of the Spiral Nebulæ

Professor Lindemann's hypothesis of the nature of

the spiral nebulæ—that they are composed of clouds of dust expelled from the galactic system by radiation-pressure and that they shine by reflected light—has been fruitful in provoking much discussion. Professor Perrine, the distinguished American astronomer who directs the Argentine National Observatory, has been working at the same problem and summarises his views in a recent article. There are several points of agreement between Professor Perrine and Professor Lindemann. According to both hypotheses the spirals have had their origin in dust-particles driven out of the galactic system by light-pressure. Dr. Lindemann, however, believes that the spirals shine by reflected light and are non-stellar, i.e. truly nebulous bodies; while Dr. Perrine maintains that these conclusions are quite untenable. "In one of these objects emission has been observed, and in at least one case known to me (N.G.C. 1,068) it is clearly established that both emission and absorption give the same radial velocity. This could not be the case if the absorption spectrum was due to reflected light." In the main, Professor Perrine holds, the spirals are composed of stars and the cosmical matter in them is merely incidental.

What, then, are the spirals? They are not external galaxies, but are "relatively small yet more or less autonomous sytems, comparable to the globular clusters, which for the most part have been ejected from our stellar system chiefly in the form of cosmical clouds by light-pressure." They have, however, now condensed to form stars, though nebulous matter is also present in them.

The great velocities indicate that they are beyond the gravitational control of our system, and are gradually becoming autonomous systems. "If the spirals," Dr. Perrine asks, "are so certainly finding their way into the great outer spaces, is it not logical to expect that there is something there for them to go to?" The bearing of this on Einstein's view of a finite universe is obvious. Also, one is tempted to ask, have we here the secret of the renewal of the universe? Will many of these comparatively small systems which we call the spirals come together and form a galaxy or galaxies similar to our own, which has, on Dr. Shapley's cosmogonic hypothesis, been formed by the union of many star-clusters? Dr. Perrine truly remarks that the study of the spirals "appears to be one of the most promising fields in the science."

The New Astronomer at the Cape

The post of His Majesty's Astronomer at the Cape, vacant by the death of Mr. Hough, has been filled by the appointment of Mr. Harold Spencer Jones, M.A., B.Sc., F.R.A.S., chief assistant at Greenwich Observatory. Mr. Jones, after a brilliant academic career, was appointed to his present post in 1913, and has been a prominent figure in the scientific world. Last year he was in charge of the Greenwich expedition to Christmas Island for the purpose of observing the total solar eclipse. Cloudy weather, however, prevented a view of the eclipse. Mr. Jones is a co-editor of *The Observatory* and author of an authoritative textbook on *General Astronomy*.

Hector Macpherson.

The Air Ministry and Atmospheric Problems

By R. J. V. Pulvertaft, B.A.

I. Testing a City's Air

London, according to a French critic, is a town which is only inhabitable because the natives spend the summer in Scotland, the winter in the South of France, and the remaining months of the year in bed. The criticism is unkind, and Londoners can at least proudly boast of one of the world's lowest death-rates. A large city, with the resources of modern sanitation at its command, has advantages unknown to the Riviera or the Highlands. But even the most patriotic Londoner cannot feel altogether happy about the smoke and impure air which he is forced to breathe. Quite apart from fogs, with their constant sequel of illnesses and deaths due to chest complaints, the pollution of the atmosphere in towns has effects which are everywhere to be noticed.

For example, many moths, which in purer air wear a coat of modest grey, are forced in London to clothe themselves in funereal colours. The pepper-and-salt moth, within living memory, has almost disappeared, in its normal variety, from the London suburbs, and has been replaced by a completely black and much smaller variety, formerly rarely seen. The spring usher moth—a delicate insect which justifies its poetic name by emerging "before the swallow dares"—takes the winds of March with its beauty, nowadays, disguised on the oaks of Wimbledon Common in a cloak of deeply banded black. Again, the Elgin marbles, which saw many a century die in Greece without losing the white gleam of their marble, have acquired in London the prevailing dingy colour of their new land. The repairs of Westminster Abbey have largely been made necessary by the decay of its stone under the influence of the impure atmosphere.

> "They dreamt not of a perishable home
> Who thus could build"—

sang Wordsworth; and they built it, therefore, of a stone very perishable in the smoke-ridden air of which, also, they never dreamed.

We are getting better, it is true. London has not nearly as unlovely a sky as it had twenty years ago; gas and electric heating have made great improvements. Though London can never hope for the gleaming whiteness of towns such as Paris, Turin, or Alexandria, her atmosphere is brighter and cleaner than many other large towns and cities. The Advisory Committee of the Air Ministry has recently published a report on Atmospheric Pollution which contains

much interesting information on the subject. London, we learn, is in far better condition in this respect than is Rochdale, and the condition of Rochdale might be improved 30 per cent. if attention were paid to smoke-suppression measures within the power of local authorities.

Much ingenuity has been shown in devising apparatus to investigate atmospheric conditions. The air is drawn through a narrow jet, after passing through a damping chamber, and strikes against a microscope slide made of glass. When air passes through such a jet under pressure, and emerges on the other side, it is cooled—a fact of which advantage is taken in the manufacture of liquid air. The moisture which was taken up in the damping chamber condenses like dew on the particles of dust and smoke in the air, and these particles stick to the microscope slide, where they can be examined and analysed.

In a fog there are about 20,000 particles of dust in London air in every cubic centimetre ; in dry, sunny weather by the seaside there are from 100 to 200. The composition of these dust-particles varies greatly. Oily matter, probably derived from tar, forms much of the impurity, and since such tar derivatives are, chemically speaking, very inert, they probably remain as permanent stains wherever they rest. We meet the same difficulty by many sea-coasts to-day, where the thick oils discarded from marine engines cover the pebbles with a sticky coat which time and tide seem only to increase in stickiness. Sometimes the air-dust is distinctly acid and, therefore, very destructive to stone and injurious to the lungs. There is a great deal of interesting reading in this little publication—ranging from comments on the probable meal-times of the inhabitants of Rochdale to the effect of industrial conditions on the purity of the air, and we trust that one result of the Committee's activities will be a renewed effort to suppress, as far as is possible, the undoubted evils of an impure atmosphere. Perhaps, before this generation has passed away, the pepper-and-salt moth may pay us the compliment of resuming its old garment of bucolic but more attractive grey.

II. Sunspots and Climate

The Air Ministry can certainly not be accused of a narrow outlook. We owe it to its Meteorological Office that the weather predictions, instead of possessing, as of old, the glorious uncertainty of cricket, have achieved a reliability almost as great as that of a billiards professional. The temperature of the upper air enables the weather prophet to interpret many signs which were formerly of uncertain import. But their activities do not end there, for at the same time as the appearance of their valuable report on Atmospheric Pollution, they have published a pamphlet on *Variations in the Levels of the Central African Lakes, Victoria and Albert.* These lakes, famous as the birthplace of the Nile, famous also in the annals of exploration and adventure, show a very strange harmony, it appears, with the mysterious spots on the sun's face which have been the subject of so much conjecture. Tables are given which appear to show that when the occurrence of spots on the sun's face is at a maximum, the levels of these lakes are lowest, and vice versa. This effect is attributed to the fact that the temperature in tropical lands is highest at " spot-maximum," and hence the evaporation on the lakes is greatest. Rainfall, of course, plays a large part in the determination of the level of the lakes ; but on occasions variations from the normal level have been noted to a marked degree without any corresponding change in the rainfall, and in these cases the association with sun-spots is remarkable. These observations are of great interest ; on the state of affairs in these central lakes depends, to some extent at least, the prosperity of Egypt, the success of the cotton crop, and, therefore, the conditions of the cotton industry in Lancashire.

Opinion is very keenly divided on the question of the influence of sun-spots on climate. In a recent number of DISCOVERY there appeared a review of a work which sought to uphold the view that they had a great influence [1] ; and certain correspondents made it plain that their opinions were of an opposite nature. This latest piece of information on the subject may well be commended to their notice.

Reviews of Books

A SOLDIER'S CONTRIBUTION TO MESOPOTAMIAN ARCHÆOLOGY

Babylonian Problems. By LIEUT.-COLONEL W. H. LANE, Indian Army (retired). With an Introduction by PROFESSOR S. LANGDON. With maps and illustrations. (John Murray, *21s.*)

" The principal scientific contribution of this book," says Professor Langdon in his introduction, " consists in new and dependable topographical information on the region between Samarra and Tell-Abir. These new maps and the description of the region given in the text constitute the best topographical information which has ever been placed at the disposal of scholars." He adds that the book " will never out-live its scientific value." Praise such as this from so eminent and critical a scholar as Professor Langdon leaves a reviewer with but little to say.

The chief problem with which Colonel Lane is concerned, and around which to a great extent centre the investiga-

[1] *Sunspots and Climate*, by Dr. A. S. Russell. DISCOVERY, March 1923.

tions described in his volume, is the topography of the ancient city of Opis, which is identified with the ruins at Tell-Abir, situated opposite the present junction of the River Adhaim with the Tigris. This location was suggested as long ago as 1841 by John Ross and Lieutenant H. Blosse-Lynch; but its acceptance by later scholars has been delayed by a difficulty in reconciling it with an inscription of Nebuchadnezzar. This difficulty a translation suggested by Professor Langdon has overcome, and the site of Opis, on which so many Babylonian problems hinge, may now be regarded as established.

Opis is the most important ancient city on the Tigris, and was founded by the Sumerians at least before 3500 B.C. It is suggested that the original name was Akshak, though Professor Langdon admits that this identification will probably give rise to criticism. At the time of the Cassite incursion into Mesopotamia it becomes U-pi-e. It possessed a cult of a deity of the lower world—a cult which Professor Langdon points out is as old as the prehistoric Elamite period of Sumerian history. It is mentioned for the last time by Strabo in 24 B.C. This gives it an existence as a thriving city of 3,500 years. Throughout this period mention of it in inscriptions and in historical records is frequent.

Colonel Lane's topographical researches make plain the reasons for its prolonged importance. As a military and irrigation centre, it was the Key of Accad and Babylon. The author claims to have located the site of Nimrod's Dam, which controlled the waters of the Tigris, and the point at which the Median Wall, constructed by Nebuchadnezzar, joined that river. With its strongly organised defensive system of canals, Opis constituted one flank of the line of defence which extended to the Euphrates, or, as he aims at showing, to Sippar. Limits of space preclude a more detailed examination here of Colonel Lane's investigations at Opis; but when, as must inevitably happen at some future date, excavations are undertaken on this important site, his work will prove invaluable in indicating the points at which investigation will prove most fruitful and the nature of the problems which it may be expected to elucidate.

Of the other matters with which the author deals, fascinating as they are, a brief mention must suffice. He discusses the question of the size and system of defence of ancient Babylon and, if he offers no solution of the controversial question of its area, he does at least suggest the line upon which the investigation of the archæologist's spade must work to afford a satisfactory answer. He also follows in the footsteps of Xenophon and his band of ten thousand Greeks in their march from the "Gates" to the battlefield of Cunaxa and in the retreat thence to Opis, offering suggestions as to the location of the two former which seem reasonably probable in their agreement with the requirements of the narrative. One of the most arresting chapters in the book, however, is his detailed elucidation of the campaign of Julian the Apostate which, after the death in battle of that Emperor, led to the disastrous defeat and capitulation of the army and lost the Eastern Empire to Rome.

E. N. FALLAIZE.

SCIENTIFIC BOOKS

The British Journal of Experimental Biology. Vol. I, No. 1. Managing Editor, F. A. E. CREW. (Edinburgh: Oliver & Boyd, 12*s.* 6*d.* quarterly.)

This latest addition to the list of learned journals should fulfil a very useful function. It is designed to cover the whole field of experimental biology. At present there is far too sharp a dividing-line between the problems of the human body, and the problems which those whose interest is mainly directed towards other forms of life have to solve. It is becoming increasingly evident that all life is essentially the same, subject to the same laws, manifesting itself by similar mechanism. This first volume contains, for example, an article by L. T. Hogben and F. A. E. Crew which serves to show how a difficult question can be decided by the use of a living creature as a kind of chemical reagent, and in this case at least without the slightest inconvenience to that creature. There were really two problems: firstly, during what month of the development of the internal secreting glands of sheep and oxen before birth do they become active? Secondly, there is a well-known monstrous calf frequently born to cows of the Dexter breed. Can this monster be compared—as has been done—to that rather rare type of human imbecile known as a cretin? The problems are really very similar, because a cretin is a child in whom the thyroid gland is inactive—and one of the marvellous medical advances of our age has been the curing of such children with thyroid gland taken by the mouth.

The problem was solved with the help of an axolotl—a creature whose history is as strange as its name. Many will recognise it as a South American amphibian, allied to our English newt, which, like Peter Pan, refuses to grow up, and breeds in its tadpole stage, under water. But if it be given active thyroid gland to eat, it develops into a lizard-like creature which lives on land. The important fact is that even the smallest amount of active gland is sufficient to make it grow up completely—it is a kind of trigger action. By using this knowledge it was discovered that the thyroid gland is not active until the fourth month of development, and that the thyroid gland of the Dexter calf monster is fully active at birth; it is not, therefore, a kind of bovine cretin. From the point of view of medical science the important fact emerges that it is possible to distinguish active from inactive thyroid gland microscopically.

Another gland—the pituitary, a small body at the base of the skull which sometimes is responsible for the occurrence of human giants—was examined by a similar method. In this case a frog was used as a test animal. The frog possesses in a lesser degree the power which we associate with chameleons of changing its colour on occasions, by the extension or retraction of special pigment-bearing cells. The injection of extract of pituitary gland makes all these cells extend—the least possible quantity turning a pale yellow frog to a coal-black one in less than an hour. It appears that the pituitary gland begins activity before the thyroid.

Other articles include a study by H. B. Fell of a case of sex reversal in a domestic fowl—a previously orthodox

hen, laying its due quota of eggs, became a cock as related by Dr. F. A. E. Crew; several intermediate conditions of sex are described, with a microscopical study of the fowls' organs; a critical summary of the marvellous work being done in the culture of living structures of the body in an artificial medium by H. M. Carleton; and an article by Julian Huxley on the basis of heredity.

The list of names on the editorial board is a sure promise that the high standard of this interesting and important number will be maintained.

Cancer: A Word of Hope. By REDDIE MALLETT. (Watts & Co., 1*s.*)

The only word of hope which this work is likely to bring is to the proprietors of a strange assortment of interests, mentioned in the text and advertised on the back page. They include a property in Devon, to which sufferers are recommended to go (apply, among others, to Reddie Mallett); a new bread, invented by the author, sole proprietors X. Y. Z.; and a prepared lemon-juice. Numerous other money-making concerns are mentioned in the course of a book which reminds us of nothing except those lists of recipes sent gratis by the proprietors of foods and flavourings, each containing a reference to their own preparations as an inevitable ingredient. It cannot be too often repeated that all nations of the world suffer from cancer, and that every variety of dietary—from vegetarianism to a pure flesh diet—is somewhere to be found. The main tenet of this pamphlet—that in diet is the cure for this scourge—is not upheld by the experience of any qualified observer; our own opinion of its object we leave to the author's intelligence.

The Advancement of Science, 1923. Addresses delivered at the Ninety-first Annual Meeting of the British Association for the Advancement of Science. (John Murray, 6*s.*)

In this volume are collected the reports of fourteen leaders of thought and research in all the branches of modern science, dealing each with one problem of present-day interest and importance. An account has already been given in these pages of the meeting, and many will doubtless be glad to possess this convenient record for further study. While those portions of the volume which deal with the atom may prove difficult reading to the general public, the greater part is devoted to subjects within the grasp of the inexpert.

Makers of Science—Mathematics, Physics, and Astronomy. By IVOR B. HART. (Oxford University Press, 6*s.*)

As a combination of biography with instruction this book is a complete success. Amply illustrated, and written in a most clear and readable style, it would seem an admirable book to introduce into the higher forms of schools, on the "Classical" as well as on the "Modern" side.

Handbook of Physiology. By W. D. HALLIBURTON, M.D., LL.D., F.R.C.P., F.R.S. 16th Edition. (John Murray, 21*s.*)

The fact that a book has gone through sixteen editions is a proof that it must have rare and remarkable features. But when we know that this book is in fact the 29th edition of Kirkes' *Physiology*, although it has changed beyond recognition in the course of years, we must realise that we have here that rarest of scientific works—a book trustworthy in every respect as a record of modern knowledge, yet capable of adaptation and expansion as new learning renders it necessary. This latest edition includes portraits of the great men in the history of Physiology, and has been expanded in several respects to bring it more fully up to date. If a student is to be confined to one textbook of physiology, this is undoubtedly the one which he should—and does—select.

A Manual of Histology. By V. H. MOTTRAM, M.A., Professor of Physiology in the University of London. (Methuen, 14*s.*)

A most welcome book. The study of the microscopical appearance of the tissues of the body is often a difficult part of the medical student's training, but it is perhaps one of the most essential. The excellent drawings really look like the structures which the student will himself see; there is nothing about what others with better eyes or imaginations claim to have seen. A few misprints have crept in—e.g. "storma" for "stroma" on page 144. But the text as a whole is commendably clear, particularly in its account of the difficult Central Nervous System. We should like to see more space devoted to the preparation and staining of sections; only the simpler staining methods are given, but these are well described, and are amply sufficient for the normal medical course. We confidently expect that this manual will meet with success. R. J. V. P.

Elementary Zoology. By OSWALD H. LATTER. (London: Methuen & Co., Ltd., 12*s.* net.)

We cannot help feeling rather sorry that Mr. Latter has written this book. He is such a master of natural history, and has such skill in presenting his knowledge of the living animal, that we feel he is wasting his talent on anatomy, even though in this textbook it is made more palatable by a medicum of physiology and natural history.

The publishers claim that the book covers the syllabus in Zoology prescribed by the University of London and the Northern Universities Joint Board for those about to matriculate. This subject forms but one of the five or six that are required. If the other subjects can only be "covered" by books of the same size and standard as Latter's *Zoology*, we think that the Society for the Prevention of Cruelty to Children really ought to intervene.

We have in this book all the minute detail which has turned Zoology into a matter of memory and not of thought and principle. Every appendage of the Crayfish has every joint named, and the unhappy beginner, not being able to distinguish between what is essential and what is not essential, struggles with such monstrosities as "dactylopodite" and "scaphognathite." Anyone who wants to know the structure, say, of the second walking leg, can surely look it up without having to learn it.

The book covers 330-odd pages, some of them containing as many as 325 words. It would make a useful

if somewhat dry textbook for the earlier part of an Honours Course in any University; but we fear it will rather "put the beginner off." Anything more terrifying than Fig. 8, a diagrammatic plan of the view of the human skull, could hardly be imagined. The illustrations are numerous and, on the whole, good; but some of them are very diagrammatic. One merit the book certainly has, and that is its moderate cost.

A. E. SHIPLEY.

MISCELLANEOUS BOOKS

An Introduction to the History of England, 1815–1880. By C. R. L. FLETCHER. (John Murray, 3*s*. 6*d*.)

Dr. Fletcher makes so engaging an apology for writing—to wit, the pleasure of scribbling—that we are straightway heartened to face with him the tortuous political history of the years 1815–1880.

Though he declares of Sir Charles Schuster and the Rev. Henry Johnson, who read the book in typescript, that "each is equally anxious to disclaim any responsibility for the opinions of the writer," we cannot believe that many people would find fault with the following statement of his estimate of the whole period: "The ideal history of the last hundred years would be one in which Simpson and Faraday would be of more account than Peel, Darwin and Kelvin than Gladstone or Disraeli." Indeed, the belief in the unimportance of the politician is the popular view in most circles to-day; there is even a danger of too great a reaction in this direction. It may be forgotten that though the statesman would do well to draw a moral from the story of King Canute and realise his impotence over the tide of progress, he is nevertheless capable of an important discretion in the building of piers and houses.

But although there is so little danger that the importance of the modern statesman will be over-estimated, we still have an exaggerated reverence for the "Great Reformers" and the "Victorian Statesmen." Most of us have been so frankly bored by the period that we were only too willing to admire all the reformers and their reforms vaguely and leave it at that. Dr. Fletcher does succeed in disentangling the various personalities and presenting them fairly to us as human beings. He even dissipates the atmosphere of irritated awe with which some men regard the Pope by such casual remarks as, "the Pope, who, poor man, had recently consoled himself for the loss of his last temporal possession, the city of Rome, by declaring himself infallible."

Dr. Fletcher has taken the period in considerable detail, covering some four hundred and seventy pages, and possibly the student who makes his first acquaintance with the period may find such detail confusing. But those who have even the vaguest knowledge of the personalities with whom he deals should find the book of real interest. It is almost a duty at the moment to become familiar with the years that followed the Napoleonic wars. While we may have but little admiration for the scrambling reforms into which the statesmen of the period were forced by the facts of social progress, we cannot but sympathise with their post-war difficulties. "If you take a file of any newspaper to-day and compare it with a file of *The Times* of those years, you will see much the same sort of remedies for present discontents—including a repudiation of the National Debt." The analogy between the position of Germany to-day and France then is too close not to have a lesson for us in dealing with the problem of Reparations. Then as now England was at some pains to urge the practical advantages of making a defeated enemy work as against the barren joy of sitting on the said enemy's head. Further, "the position of Russia was not unlike America, 1918–19; she had come comparatively late and unwilling into the war of which Britain and Austria had for many years borne the brunt; but the accidents of her geography and her climate enabled her to ruin Napoleon." Her advantageous position further enabled her with England to force reasonable terms for France from the other Allies. The trade revival made possible by this settlement is an excellent illustration of the fact that the quality of mercy "blesseth him that gives and him that takes."

It remains to be seen whether the present League of Nations will meet the fate of that "sort of League of Nations," the Holy Alliance. There is room for hope in the fact that science has made a more intimate knowledge and understanding of our neighbours possible. Further, the scientific mind and subsequent attitude towards life is daily becoming more common, and as the author says: "An entire devotion to any branch of Natural Science probably leads to the happiest life of which a man is capable. . . . In the pure and rarefied atmosphere which they breathe the horrors of politics pass unheeded, the zeal for discovery swallows up the lust for fame, and little room is left for personal, and none for international, jealousy."

E. L. M. P.

Below the Snow Line. By DOUGLAS W. FRESHFIELD, D.C.L. (Constable & Co., Ltd.)

A former president of the Alpine Club and Royal Geographical Society and a mountaineer in the Caucasus, Italian Alps, and Himalayas, describes with much colour and erudition climbs and adventurous wanderings in the Maritime Alps, Corsica, the Apennines, North Africa, and elsewhere.

The Elephant Man and Other Reminiscences. By SIR FREDERICK TREVES. (Cassell, 7*s*. 6*d*.)

This book may please lovers of abnormal and morbid subjects. It struck the reviewer as neither a work of art nor as a piece of entertaining reading.

A Fairy-tale of the Sea. By MACLEOD YEARSLEY. (Watts & Co., 3*s*. 6*d*.)

This is an attractive little book which may amuse and instruct (a little) the very young. Just the thing to while away a wet day at the seaside or a too hot day when even paddling palls, and nothing but a "story," with head in shade and feet in a pool, can pacify the day's fretfulness.

The author should realise, however, that italics in excess reveal the prentice hand; and that a too colloquial

style, even in children's and fishes' conversations, is not the best. And it seems a pity that what is meant for children should not be of the best, in however humble a sphere.

Miss Alice Woodward is to be congratulated on her illustrations; they are clear and charming, and, drawn with a characteristic humour, must add considerably to the value of the book in grown-up eyes as well as in those of the younger generation for whom it was intended.

Books Received

(Mention in this column does not preclude a review.)

The Wonders of the Stars. By JOSEPH McCABE. (Watts & Co., 3*s.*)

The A B C of Atoms. By BERTRAND RUSSELL. (Kegan Paul, 4*s.* 6*d.*)

Botany. A Junior Book for Schools. By R. H. YAPP (Cambridge University Press, 3*s.* 6*d.*)

Roman Britain. By R. G. COLLINGWOOD, F.S.A. (Oxford University Press, 2*s.* 6*d.*)

Indian Bird Life. By M. R. N. HOLMER. (Oxford University Press, 3*s.* 6*d.*)

Elementary Mathematical Astronomy. By C. W. C. BARLOW, M.A., B.Sc.; and G. H. BRYAN, D.Sc., M.A., F.R.S. (University Tutorial Press, 9*s.* 6*d.*)

Elementary Hygiene. By BIHARI LAL BHATIA and PREM NATH SURI. (Longmans, Green & Co., 2*s.* 6*d.*)

Animal Parasites and Human Disease. By ASA C. CHANDLER, M.S., Ph.D. (Chapman & Hall, Ltd., 22*s.*)

The New Physics. By ARTHUR HAAS. (Methuen, 6*s.*)

Makers of Science. By IVOR B. HART. (Oxford University Press, 6*s.*)

The Kingdom of the Heavens: Some Star Secrets. By CHARLES NORDMANN. Translated by E. E. FOURNIER D'ALBE. (Fisher Unwin, 12*s.* 6*d.*)

Variations in the Levels of the Central African Lakes Victoria and Albert. By C. E. P. BROOKS, M.Sc. (Published by the Meteorological Committee, 1*s.* 6*d.*)

The Subject Index to Periodicals, 1920. F, Education and Child Welfare. (Issued by the Library Association. Published by the Library Association; agents: Messrs. Grafton & Co., 4*s.*)

Probité Scientifique. Par MAURICE LECAT. Chez l'Auteur, Louvain.

Sul Principio delle Energie di Moto e Sulle sur Consequenze. ING. GAETANO IVALOI. (Societa Editrice Libraria, Milano.)

The New Natural History. Being the Twenty-fifth Robert Boyle Lecture. By PROFESSOR J. ARTHUR THOMSON, M.A., LL.D. (Humphrey Milford, 1*s.*)

Seventy-seventh Annual Report of the Director of the Astronomical Observatory of Harvard College for the Year ending September 30, 1922. By HARLOW SHAPLEY. (Published by the University, Cambridge, Massachusetts.)

On the Form of the Distribution Law of Stellar Velocities. Reprint 2. By WILLEM J. LUYTEN. Reprinted from the *Proceedings of the National Academy of Sciences.*

Report on Observations in the Year ending March 31, 1922. By the Meteorological Office Air Ministry Advisory Committee on Atmospheric Pollution. (His Majesty's Stationery Office, 3*s.*)

Essai son la Cause de la Gravitation. Par N. SAKELLAROPOULO. (Le Caire.)

Local Geology. A Guide to Sources of Information. By A. MORLEY DAVIES, D.Sc., F.R.G.S., F.G.S. (Thomas Murby & Co., 1*s.*)

Origins in Place-names. II, Sound; III, Growth. By AN IGNORANT STUDENT. (Privately printed at the Chiswick Press.)

A Manual of Practical Dactylography. A Work for the Use of Students of the Finger-print Method of Identification. By DR. HENRY FAULDS, F.R.Anthrop.I., etc. (*Police Review* Publishing Co., 2*s.*; cloth, 3*s.*)

Some Primitive Stone Implements from Uganda. By REGINALD A. SMITH, B.A., F.S.A. With an Introduction by E. J. WAYLAND, A.R.C.Sc., F.G.S., M.I.M.M. Occasional Paper No. 1 issued by the Geological Survey of Uganda, Entebbe. (Government Press, Uganda.)

The Universal Law of Organic Progress. By DANIEL NELSON CLARK, LL.B. (Ingersall & Harrison, Los Angeles, California, 15 cents.)

The University of Liverpool Tidal Institute's Fourth Annual Report, 1923.

The British Journal of Experimental Biology. Vol. I, No. 1, October 1923. (Edinburgh: Oliver & Boyd, Quarterly, 12*s.* 6*d.*)

The Advancement of Science. Addresses delivered at the Ninety-first Annual Meeting of the British Association for the Advancement of Science. (John Murray, 6*s.*)

Harrap's New World Atlas in Contour Colourings. Edited by JOHN BARTHOLOMEW, F.R.G.S. (George G. Harrap & Co., Ltd., 1*s.*)

Guide to Dairying in South Africa. By R. BROUGHAM COOK. (Basil Blackwell, 15*s.*)

Recent Developments of the Atomic Theory. By LEO GRAETZ. Translated by GUY BARR. (Methuen, 9*s.*)

Earth and Sun. By ELLSWORTH HUNTINGDON. With a chapter by H. HELM CLAYTON. (Humphrey Milford, 28*s.*)

The Origin of Magic and Religion. By W. J. PERRY. Methuen, 6*s.*)

The Botany Gardens of the James Allen's Girls' School, Dulwich. By LILIAN J. CLARKE, D.Sc., F.L.S. (His Majesty's Stationery Office.)

ERRATUM

Theories and Problems of Cancer, by C. E. WALKER, D.Sc., M.R.C.S., L.R.C.P., is published by the University Press of Liverpool, Ltd., and Hodder & Stoughton, Ltd., price 5*s.*

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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Editorial Notes

WE regret to have to inform our readers that this is the last number of DISCOVERY which will be published. No earlier announcement could be made, since efforts to preserve the life of our journal were continued almost up to the day on which this number was sent to press. The years after the late war have seen the initiation, the rise to popularity, and the fall in circulation of many magazines beside this one. Perhaps the chief cause of these failures lies in the depression in trade following so closely on the artificial prosperity that appeared after the Armistice. The result of this depression has been twofold: the cost of producing magazines has increased and the reading public has had less money to spend on them. We do not complain of our lot; from the outset we have striven to keep our readers in touch with the latest advances in knowledge both in the Sciences and in the Humanities.

* * * * *

In taking farewell of our readers, we think that a brief recapitulation of DISCOVERY'S short existence will not be out of place. The first conception of the journal was due to the late Professor Julius Macleod, of Ghent, a distinguished Belgian botanist, who was a guest of the University of Manchester during the war. His suggestion led to a special conference between a committee of the Council for Humanistic Studies and a committee of the Conjoint Board of Scientific Studies. As a result of this conference, negotiations were started and, through the enterprise of Mr. John Murray, our publisher, eventually ended in the appearance of the first number of DISCOVERY in January 1920. From the outset the magazine was under a deed of trust, the then Presidents of the Royal Society and of the British Academy being two of the four trustees, while a Committee of Management was formed, consisting of representatives of the National Union of Teachers, the Co-operative Union, the Library Association, the Incorporated Associations of Head Masters and Head Mistresses, the Head Masters' Conference, the Conjoint Board of Scientific Societies, the Classical, Historical, English, Geographical, and Modern Language Associations, the British Psychological Society, and the Royal Society of Economics. It was largely due to the help of these specialist societies that DISCOVERY was able to secure a supply of articles written by the men who were actually undertaking the investigations described, or were in other ways specially fitted for the work of reducing technical scientific phraseology to intelligible and interesting language.

* * * * *

We venture to say that no popular magazine published in England has ever before marshalled such an array of scientists and research workers in the Humanities in its army of writers. In the list of its contributors stand out such names as those of Sir Oliver Lodge; Sir William Bragg, one of the greatest pioneers in the wonderful modern researches into the structure of matter; Professor Sir Flinders Petrie, the greatest living authority on the life and history of the ancient Egyptians; Dr. C. S. Myers, a famous English psychologist; Sir Arthur Shipley; Professor A. C. Seward, whose work on fossilised plant-life has opened new vistas in the study of Botany; and Professor Conway, whose name is associated with the modern school of classical scholars that has revolutionised the study of the Greek and Latin civilisations and languages by showing the vast importance of their contributions to the civilisation of our own day. Among younger scientists who have described their researches and experiments in our pages have been

Professor A. V. Hill, who has this year been awarded the Nobel Prize for his work on oxygen and human energy; Mr. Julian Huxley, an Oxford biologist and grandson of the famous scientist, whose writings and experiments have attracted the keenest interest since the war; and Professor W. L. Bragg, who has co-operated with his father in recent epoch-making researches into crystal structure. It was in DISCOVERY that Professor Alfred Wegener first described for the British public his new theory of the origin of continents and oceans—a theory which has startled the world with its revolutionary conception of the nature of the surface of the globe. In the realms of archæology we have been fortunate in securing descriptions from the excavators themselves of three highly important post-war discoveries: Professor Peet has described his work on the site of the ancient city of the sun-cult at Tel-el-Amarna, in Upper Egypt; Professor Zaminit his discoveries of temples dating back to the later Stone Age in Malta; and Dr. Hall and Mr. Woolley their romantic "finds" in Southern Iraq of the temples and palaces of Ur of the Chaldees.

* * * * *

A leading article in the *Manchester Guardian* not long ago described DISCOVERY as "a sort of war correspondent of peace-time. It fetches to us laymen at home the exciting news from the various fronts where science is gaining hard-fought ground." Science has certainly gained much ground since the end of the war, and our knowledge of the universe and of life has been greatly increased, as also our knowledge of man in the distant past.

The teachings of Freud, Jung, and Adler have received widespread attention since the war, when psycho-analysis has been first seriously used in this country to cure nervous disorders. A vast literature, fictional as well as technical, has grown up in mush-room fashion on this remarkable science, which, despite its extremists and its conflicting schools, has already done much good in the treatment of abnormal characters and which is destined to teach us a great deal more about the normal human mind than we have ever known before.

Even more notable, perhaps, have been the strides made in physics and chemistry with Einstein's theory of Relativity and the work of Thomson, Rutherford, Chadwick, the Braggs, Soddy, Aston, Bohr, and other pioneers, which, by revealing to us the electrical composition of the atom, has put a completely new interpretation on the structure of matter throughout the universe.

Since the war physiologists have made rapid advances in the study of the ductless glands, or endocrine system, and the value of their secretions in building up and maintaining the human body; one of the practical results of this investigation has been the invention of insulin early this year, an extract of the pancreas gland of sheep used with considerable effect in the curing of diabetes. This year, too, bacteriologists have come very near to discovering efficacious inoculations against tuberculosis; time alone will show their value, but we can at least say that we are one stage "nearer home" in this direction. The problem of cancer is still far from being solved, but this year, again, has seen the initiation in England of a general campaign against the terrible disease.

Our knowledge of prehistoric times has greatly increased during the last four years. Indeed, it may be said that much of what was prehistory before the war is now becoming history. An article in this number demonstrates how archæologists and geologists have been tackling the question of whether man existed as far back even as the Tertiary Age. Many remarkable archæological "finds" have been made in Crete, Greece, Mesopotamia, and elsewhere, but, of course, the most sensational has been the discovery last year of Tutankhamon's burial-place, which has given us tangible, beautiful, and enormously valuable relics of the earliest known civilisation.

* * * * *

The application of new knowledge to industry and human endeavour generally has been attended with wonderful successes. The highest mountain in the world still remains unconquered, but we venture to think it will not hold out much longer. It is now no remarkable event in a business man's life to fly by aeroplane from London to Paris; speeds of over 250 miles an hour have been attained by aeroplanes, and a new class of light air machine with an engine of a few horse-power seems destined ere long to usurp not only the light car, but the motor-bicycle. This year has witnessed the consolidation of a wireless service within the reach of almost everyone, and the spectacle of families in the cottages of villages listening to concerts in London, Manchester, and even Paris. We are not likely ever to conquer earthquakes, but, as narrated in an article in this number, a scientist in England was wakened in the night, through the medium of an electric bell attached to his seismograph, by the recent earthquake in Japan.

* * * * *

The world in which our venture has played its part has been harassed by the aftermath of war and the perils of new wars. Only an optimistic person would predict that there is no danger of Europe being plunged into a war, that will overwhelm her civilisation, within the next fifty years. The alternative of peace is so entrancing, with its vistas of the application of

science to the task of harnessing the world's resources, and of an increasing spirit of international friendship in the general march forward of humanity, that we shall rest content if our journal has lit a small torch on the pathway of progress.

A Buddhist Traveller of the Fifth Century A.D.

At a time when "self-interest" is advocated as a moral code to influence the actions of individuals and nations, it is encouraging to turn to the lives and teachings of the founders of the two greatest religions the world has yet been given, Buddhism and Christianity, and to those of the men who subsequently spread and fostered them.

It will be remembered how Gautama Buddha left his young wife and one-day-old child, and rode away into the Indian night, having renounced everything that was precious to him. That was 2,500 years ago, and many travels, pilgrimages, and wanderings have since been performed by his followers. None, perhaps, has been more remarkable than the travels of Fa-hsien, which even vie with the journeyings of St. Paul in the matter of dangers encountered, and certainly exceed them in the distances covered. This Chinese *shaman* set out from Ch'ang-an, in Central China, in A.D. 399, being "distressed by the imperfect state of the Buddhist *Disciplines*" and wishing to obtain these "Rules" in India. He walked practically the whole way across the Desert of Gobi, over the Hindu Kush and down through India to the mouth of the Hoogly River. Thence he took ship to Ceylon, where he remained for two years, finally returning by ship to China through the Sunda Strait. It took him fifteen years to accomplish his journey; he brought back with him the objects of his quest—books of the Buddhist Canon and images of Buddhist deities; and subsequently "he wrote down on bamboo tablets and silk an account of what he had been through, desiring that the gentle reader should share his information."

The first translation into a European language of this "Record" was the French version of Rémusat, published in 1836. Of later translations that of Professor H. A. Giles into English is most worthy of mention. It was first published in 1877, and this great Chinese scholar has now given the English public a revised version of his work.[1] "From this little book of travel," says the translator, "the unbiased reader may perhaps obtain a furtive glimpse of the grandeur of the Buddhist religion in the early years of the fifth century A.D." Fa-hsien's records show the vast institutional development, that had taken place in a thousand years, among Oriental peoples of the original simple and beautiful doctrines of primitive Buddhism. The monasteries, housing thousands of monks each, the richly built pagodas, the elaborate ritual of worship, the hundred and one places superstitiously associated with Gautama's saintly acts and endurances, legends and relics of all kinds, existing at that date from Tibet to Ceylon, are described by the *shaman* in vivid detail.

A typical passage is that relating to Ceylon, "not originally inhabited by human beings, but only by devils and dragons": "When Buddha came to this country, he wished to convert the wicked dragons; and by his divine power he placed one foot to the north of the royal city and the other on the top of Adam's Peak. . . . Over the footprint to the north of the city a great pagoda has been built, four hundred feet in height and decorated with gold and silver and with all kinds of precious substances combined. By the side of the pagoda a monastery has also been built, called No-Fear Mountain, where there are now five thousand priests. There is a Hall of Buddha of gold and silver carved work with all kinds of precious substances, in which stands his image in green jade, over twenty feet in height, the whole of which glitters with the seven preciosities, the countenance being grave and dignified beyond expression in words. On the palm of the right hand lies a priceless pearl."

Much research is now being made into the fundamental teaching of Gautama, which is being studied from the original sources. As in the case of Christianity, it has been overlaid with a complicated fabric of ritual and legend; "common men," as Mr. H. G. Wells [2] has said, "must have their cheap marvels and wonders." But at the same time it is universally acknowledged that the growth of both religions has inspired mankind with new and higher ideals and has been responsible for much of the world's finest literature and works of art.[3] Unselfishness and regard for truth are the central teachings of both religions. As a worker in the cause of Buddhism Fa-hsien lived up to its central doctrines. "That in the dangers which I encountered whether riding or on foot," he explained to one who met him at the end of his travels, "I did not spare my body, was because I kept my object steadily in view and concentrated upon it a simple honesty of purpose."

In the autumn months many a road in the East is still thronged with bands of Buddhist pilgrims going from one monastery to another. From a guide-book carried on such pilgrimages Dr. Carpenter, in his book referred to, cites a counsel of piety recorded originally by Mr. R. F. Johnston in his *Buddhist China*. It bears an interesting resemblance to the utterance of Fa-hsien: "It should be remembered that the proper object of the pilgrim's quest is truth; he must not expect to find his task an easy one. In this world of ours we cannot hope that heaven will make Buddhas of us for the asking. It is not till the plum-tree has endured the icy rigours of winter that its blossoming time will come. It is not till the pilgrim has won his way with zeal and courage through all the pains and woes of human life that he can hope to attain the objects of his quest."

EDWARD LIVEING.

[1] *The Travels of Fa-hsien* (A.D. 399–414), *or Record of the Buddhistic Kingdoms.* (Cambridge University Press, 5s.)

[2] Vide his *Outline of History*, chapter xxv: *The Rise and Spread of Buddhism.* (Cassell & Co., Ltd.)

[3] In Dr. J. Estlin Carpenter's recently published book on *Buddhism and Christianity* (Hodder & Stoughton, Ltd., 3s. 6d.) the reader will find the most luminous account of the teachings, development, and the contrasting and similar characteristics of the two religions yet written.

Earthquakes

By J. J. Shaw

Honorary Secretary, Seismological Committee of the British Association

The investigation of earthquake phenomena, or Seismology, constitutes a most interesting study. It is really remarkable that, whilst other sciences have attracted so many workers, seismology has been almost entirely neglected. Perhaps this is because experimenters have not yet realised its fascinations, or maybe because earthquakes are not of everyday occurrence.

It is not necessary to live in an earthquake country in order to engage in their study; since it is possible to construct instruments, called seismographs, for the purpose of recording in diagram form—the seismogram—the various wave motions which are propagated uniformly throughout the Earth's mass.

By this means the exact time of their occurrence can be computed, also the precise area where they occur can be located, even if they are in the bed of an ocean; in fact, the greater number of shocks are located at the bottom of the sea.

An earthquake is by far the greatest demonstration of energy of which we have knowledge. It is capable of setting the whole Earth pulsating from pole to pole. The great earthquake in China in 1920 shook mountain ranges down until the valleys were filled up. The recent catastrophe in Japan furnishes us with an example of its destructive force. It is not uncommon for hundreds of thousands of lives to be lost in a few seconds.

Several attempts have been made to calculate the amount of energy liberated; in the case of a severe shock it is estimated to be of the order of 50,000,000,000,000 (fifty billion) kilowatts.

This energy radiates outwards in every direction: not only does it traverse the whole surface of the Earth, but it permeates also every cubic yard within. It is propagated in the form of waves of various types, each type having a characteristic speed.

Determining the Distance

In the same way that the distance of a gun may be determined from the flash and the sound, so also may an earthquake's distance, and the time at which it occurred, be computed.

There are three principal types of wave available for observation. The first to arrive at an observing station comes through the interior of the Earth in the form of a concussion, and is known as a compressional wave. The speed of this wave varies from 7 to 13 kilometres per second, depending upon the depth to which the chord, along which it travels, penetrates. This phase is denoted by P (primary). (See Fig. 1.)

The second type of wave travels via the same chordal route, but at a slower speed than the primary waves, viz. from 4 to 7 kilometres per second. These are transverse waves, so called because the vibrations, as in light waves, are at right angles to the path along which they are travelling. These waves are not only slower in speed, but the pulsations are also fewer per second, and have greater power. These characteristics give a wider and more open diagram, enabling them to be distinguished from the preceding primary waves. They are designated by the letter S (secondary).

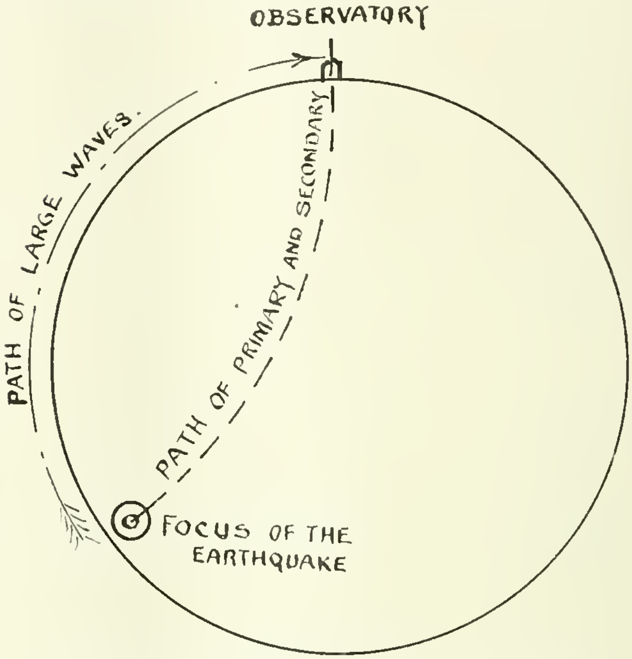

FIG. 1.—SHOWING THE PATHS OF THE PRIMARY, SECONDARY, AND LARGE WAVES.

Waves of the third type are similar to those waves which travel across a pool—they pass outwards from the epicentre, as the point on the surface above the origin is called, in ever-increasing circles, at $3\frac{1}{2}$ kilometres per second, along the Earth's crust. They are responsible for the largest part of the record and are known as the large waves, or maximum.

The evidence that these waves travel along the surface lies in the fact that, no matter how far they are propagated—and they sometimes pass more than once round the Earth—they travel at a constant speed relative to the distance measured on the surface; whereas the ratio of the length of a chord to the surface distance is constantly changing.

Since it is possible to recognise these different types of wave in the seismogram, it is obvious that these are the necessary data for estimating the distance they have travelled.

Let us take an illustration to make this point clear. If two trains leave London for the North, travelling at 60 and 30 miles per hour respectively, the express will reach a point 60 miles distant in 60 minutes, whereas the slow train will pass the same point in 2 hours, just 60 minutes later than the express. It is seen that the slow train is getting late at the rate of one minute for every mile run, hence at any point in its journey its lateness in minutes equals its distance in miles from London.

So with the earthquake ; the velocities of the various types of wave being known, as a result of many observations on previous shocks, the difference in the time of arrival of any pair is a measure of the distance of the origin, their common starting-place. For instance, when the secondary waves arrive 9 minutes 25 seconds later than the primary, the distance of the earthquake from the observatory is 5,000 miles ; and it can be further computed that the shock occurred 11 minutes 35 seconds earlier than the time of recording the first primary wave.

Before leaving this question of rates of propagation, it is interesting to remark that the first impulse arrives at the antipodes in about twenty-one minutes, after which, in the case of severe shocks, the whole Earth continues to pulsate for four to five hours ; and though it is far too feeble to be felt, every particle of matter and every living soul are rocked to and fro during this time. The titanic force of an earthquake is too stupendous for our full comprehension.

Locating the Position

The first primary wave which arrives at a station indicates the direction. It is either a " push " or a " pull " in a direct line with the centre of the shock. If this wave is accompanied with a rise of the ground, it is a " push " ; if the ground falls, it is a " pull."

Where a station is fitted with apparatus for recording all three components, namely, north–south, east–west, and the vertical motion, and a good record is obtained, it is possible to determine the direction from the data of one observatory.

A more satisfactory method is that where three or more observatories compare their readings. Each station calculates its distance from the epicentre. With three such distances as radii, and the respective stations for centres, circles are drawn upon the globe. At one point all three circles will meet. It will be at that point where the earthquake has occurred.

More precise determinations are made by the University Observatory at Oxford. This station, under the supervision of Professor H. H. Turner, F.R.S., is the international centre for collecting the reports from the various observatories throughout the world.

Earthquakes occur chiefly along well-defined belts on the Earth's surface. One belt nearly encircles the Pacific, the other stretches in a fairly straight line from the West Indies through the Atlantic Ocean, Southern Europe, and Asia, terminating in a fork running into Japan and the East Indies.

When the distance has been calculated for any station, a circle of that radius may be described around it. It is then possible to note at which points the circle cuts the main belts, thus narrowing down the possibilities where the earthquake may be. This method lacks very considerably in accuracy, but in

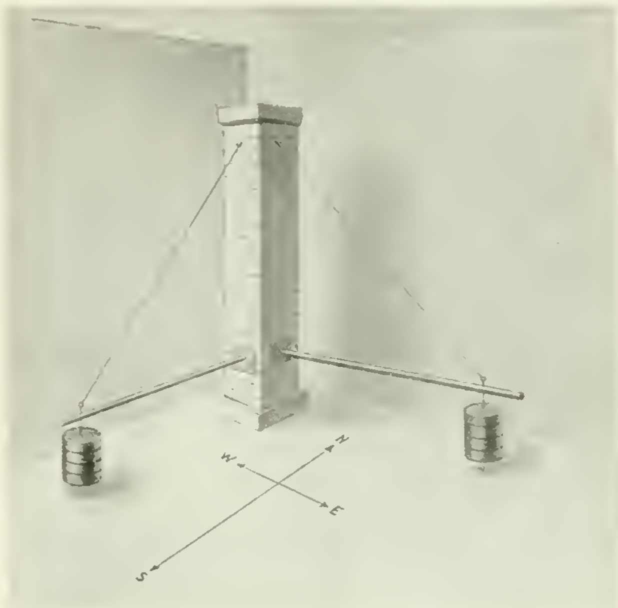

Fig. 2.

the absence of other data it has the merit of being expeditious.

The Seismograph

Let us now consider the apparatus whereby the record, or seismogram, is made.

The basis of the seismograph in most cases is a pendulum whose movements, relative to the surface of the ground, are highly magnified before recording them.

The usual clock pendulum swings vertically, fairly quickly, and is not sufficiently sensitive for the work. It has been found that when a pendulum is mounted horizontally as shown in Fig. 2, where the top point of support is nearly vertically above, but a little forward of the lower point on the rod, it beats much more slowly, and becomes considerably more sensitive either to a horizontal thrust or tilting of the ground.

If the Earth movement approaches the pendulum end on, the pendulum is not affected ; therefore to

record movements from all points of the compass, it is necessary to mount two pendulums at right angles as shown in the figure.

In practice, one of the points of support is fitted with screw adjustments to regulate the degree of verticality. The more vertical these two points are set, the more horizontal becomes the plane in which the pendulum swings. This has the effect of lengthening the time for each swing, and the corresponding sensitivity increases as the square of this time of swing. Periods up to 30 seconds per swing are easily obtained, when the pendulum becomes from 200 to 300 times more sensitive than the usual seconds pendulum in a clock. But even so, when it becomes a question of being operated by the tiny wavelets that survive after radiating through solid material for

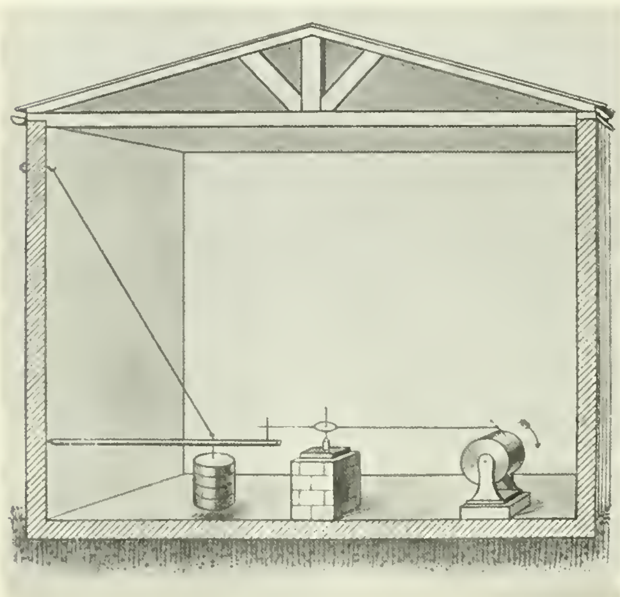

Fig. 3.

thousands of miles, the recorded movements are much too small to be of service, and this is where the designer or experimenter meets his great difficulty, namely, how to add a further great magnification when the restoring force of the pendulum has been reduced to its lowest ebb.

There are two alternatives: (*a*) increasing the weight of the pendulum; (*b*) reducing the friction of the magnifying devices to the utmost limit.

The former has been carried to one extreme, both by the Italian and German designers. Pendulums weighing as much as two tons are in use. In this case it is usual to use mechanical levers and pointers recording on smoked paper; and in some instances siphon recorders using ink on white paper.

Fig. 3 illustrates in diagrammatic form a seismograph recording on smoked paper.

The rod of the pendulum is 5 ft. long, carrying a weight of 300 lb. The lever magnifies the pendulum motion thirty times. The outer end carries a pivoted glass needle which is almost in equilibrium, but has a very feeble bias and so falls lightly upon the smoked surface of the recording drum. The recording pointer is raised from the smoked surface once per minute by means of an electromagnet not shown in the figure. This breaks the continuity of the line and so imposes the time upon the trace.

The drum is constantly revolved by a clockwork motor, and at the same time made to travel endways along the recording box. The trace drawn by the pointer forms a helix from one end of the drum to the other as a result of the two combined motions.

When a pendulum is disturbed, it requires a considerable time to come to rest. To obtain a true record of the ground movement, it is necessary to eliminate this natural tendency of the pendulum. For this purpose damping devices are used: such as vanes fitted to the pendulum and arranged to float in an air chamber or oil bath. A later and superior method is the utilisation of a copper vane floating in a strong magnetic field.

In the case of the heavy type of pendulum it is possible to fit an electric alarm. A bracket arm fitted to the outer end of the pendulum carries a platinum horseshoe, one leg of which rests in a globule of mercury; the other leg stands adjacent to a second globule whose distance is adjustable. These globules are the terminals in an electric-bell circuit.

The second globule is adjusted so as almost to touch the platinum contact. In this position the smallest oscillation of the pendulum rings the alarm. It was this device, the only one in this country, which roused the writer from bed a few minutes after the recent earthquake in Japan had occurred.

In the later and more delicate forms of seismograph the pendulums are sometimes as light as 1 lb.; the magnification is then achieved optically by moving beams of light recording on photographic film.

In another type the magnification is obtained electrically. The pendulum is fitted with a series of coils of copper wire which float in a magnetic field.

When the pendulum moves an electric current is induced in the coils and passes on to a recording mirror galvanometer.

Causes of Earthquakes

The cause of an earthquake has always been a subject for speculation. Neither Religion nor Politics have excited more controversy than this vexed question. The multiplicity of theories is a direct result of the paucity of real knowledge. It is generally

agreed that the focus of the shock is deep-seated, at a position in the Earth's interior where the conditions are unknown. It used to be fashionable to speak of the Earth's crust as about forty miles thick, and to believe that shocks occurred within that solid covering. Now, from observations of the variation in the time occupied by the primary waves in arriving at the antipodes, there is evidence to suggest that the seat of an earthquake may be as deep as 400 miles. The constituents of a star millions of miles away, by the aid of the spectrograph, are infinitely easier to investigate than the conditions a few miles beneath our feet.

As an instance of the diversity of opinion, two theories stand out in bold relief:

(*a*) The Earth is a cooling mass in which its outer shell has already become tolerably cool and solid. The interior continues to cool and contract, leaving the overcoat too large for the body. The overcoat wrinkles and creases like the skin of a drying apple. When the wrinkling reaches the elastic limit, the rocks snap, producing an earthquake.

(*b*) The Earth is a hot body whose outer shell is cooling and has become solid, and in its continued contraction becomes too small and too tight for the plastic interior, with the result that it occasionally cracks along lines of weakness.

Connection with Volcanoes

It is, perhaps, only natural that one flies to the volcano in the hope of fathoming the secrets of the interior, and it is a common impression that volcanoes are closely bound up in the earthquake phenomenon. This hypothesis appears to break down on closer examination.

When a volcano is in eruption, it almost invariably follows that earthquakes will be felt in the vicinity, but these shocks rarely provide sufficient energy to operate seismographs beyond a radius of a few hundred miles; suggesting that they are only minor adjustments after lava has been ejected, and are of a comparatively local character. On the other hand, the majority of the greater earthquakes emanate from regions where no volcanoes exist. This has been put forward as evidence that volcanoes are the safety-valves which prevent earthquakes. Not all the volcanoes in Japan, of which there are many, saved Tokio and Yokohama from destruction.

Another theory suggests tidal forces, where the Earth is supposed to be liquid within, and fitted with a thin, cold skin. The Sun and Moon as they pass set up a tide in the liquid interior similar to the tide in the sea, and so on occasions disrupt the crust and produce an earthquake. In this case it should follow that at the time of new moon there would be a preponderance of shocks. The examination of 15,000 earthquakes showed a preponderance amounting to 4 per cent. at this period; on continuing the examination and using 140,000 earthquakes, the law of average asserted itself and wiped out even this small excess.

The Latest Theory

The suggestion which has gained most favour, and seems to fit in with many observations, is the theory of Isostacy, which contends that all visible land is composed of the lighter parts of the Earth's crust and is floating upon the components of greater density.

Every mountain has its stream; every stream is gradually but continually conveying fine sand in suspension and soluble salts in solution to the sea. In the millions of years that have passed it is surprising that all land has not been washed into the sea, for there is ample room. If all the visible land were laid upon the bed of the oceans, there would be water to a depth of 1,200 ft. over all.

There certainly must be some process of restoration. The suggestion is that the Earth's outer shell is composed of great areas of material of different densities, and that the lighter areas float upon and in the heavier ones, in precisely the same way as icebergs float in the sea. If the difference in weight is small, the amount showing above the surface is also small compared with the amount immersed. In the case of the iceberg there is nine times as much below as above; and whenever the sun melts a layer from the top, the whole floats upward to re-establish the equipoise.

So with the mountain; as the tops are worn off they gradually rise above the plain, and of necessity require to break away round their lower edges where they meet the lower-lying ground in which they float.

It is this periodical act of severance which constitutes the earthquake.

The evidence to support this hypothesis is fairly comprehensive, and its chief points are—

1. The materials of which mountains are composed are generally lighter than that of the surrounding plains.
2. Evidence of sea-beaches on mountain-sides.
3. Marine deposits found at high altitudes.
4. That nearly all the great earthquakes occur either at the foot of mountain ranges, or at the bottom of steep declivities in the ocean bed.

But it is unwise to dogmatise on the cause of earthquakes; one can merely indicate the lines of modern thought. Probably there is a modicum of truth in them all.

Did Man Exist in the Tertiary Age?

By E. N. Fallaize

When once it had been established to the satisfaction of the most prominent scientists of the day that the flints—afterwards known as palæoliths—discovered by Bourcher de Perthes in the Somme Valley in 1848 had been shaped by human agency, and were contemporary with the gravels in which they had been found, a vast field of speculation and research was opened up to the student of the history of man. These implements came from deposits assigned to the Pleistocene Age, which was the earliest stage of the Quaternary Epoch—the last of the divisions into which geologists had divided the earth's history as revealed by its rocks, and their associated characteristic fossils—and immediately preceded the "recent" times of present conditions. The exploration of Brixham Cave in 1858 confirmed the suspicions aroused by earlier discoveries in caves that man had lived contemporaneously in Britain with animals now extinct. These facts added thousands of years to the period during which, it was traditionally held, man had inhabited the earth.

Origin of Eoliths—Opposing Theories

The publications of Darwin and of writers of the evolutionary school made familiar the idea that man and his culture were the products of a long course of development. By experiment archæologists learned the difficulties of manufacturing flint implements and came to appreciate the fact that the palæolith was by no means the rude stone implement of the popular writer, but was the result of long experience and the product of a highly developed technique. They turned, therefore, to the deposits of the Tertiary Epoch, the third of the great divisions of geological time, in the hope of discovering examples of an earlier and more primitive style in man's industry in stone which would serve as evidence of his existence in that era. Nor was it long before this was forthcoming. In 1867 L'Abbé Bourgeois announced at the International Congress of Anthropology and Prehistoric Archæology that he had discovered flints which bore evidence of human handiwork in the Tertiary gravels of Thenay. From that date students of the early phases of man's development have divided into two groups. On the one side stand those who accept the human origin of specimens for which Tertiary age is claimed, and continue from time to time to bring forward fresh evidence to support their case; while on the other side their opponents hotly contest the inferences which they draw. A vast literature has grown up around the subject in which the violence of the opposing sides is often more remarkable than the finality of their arguments.

It is not proposed here to examine in detail the arguments of either side, or to discuss *seriatim* the discoveries from various sites which have been held to be examples of the handiwork of Tertiary man. It is, however, necessary to review the question summarily in order to appreciate the bearing of certain recent investigations which appear to advance an appreciable stage towards a final solution.

To understand the nature of the problem of Tertiary man, it must be remembered that there are two questions involved: (1) What is the geological horizon from which any given specimen is derived, and, if the deposit is of Tertiary age, is it undisturbed, so that any specimen for which human origin is claimed may without any question be regarded as a contemporary with the associated gravels, fossil shells, remains of animals, etc.? (2) Are the chipping and shaping of the flint the result of purposive human action? This is a question of extreme difficulty, and in the majority of cases the one upon which opinion is divided with little prospect of agreement. Its consideration involves a highly technical knowledge of the mode in which a flint will fracture in different circumstances. It is well known that flint fractures under pressure and under the influence of heat or cold. The opponents of the eolith maintain that all specimens for which human purposive action is claimed are the result of the action of natural causes. Even the bulb of percussion which arises when a flint is broken by a violent blow, owing to the elasticity of its substance, can be produced by these forces, although it was once regarded as indubitable evidence of human handiwork. M. Marcellin Boule, some years ago, exhibited a number of specimens of typical eolithic character which had been produced by a stone-crushing machine in a cement factory. Mr. Hazzledine Warren, possibly the most determined opponent of the eolith in this country, has found in deposits in Essex specimens which he regards as typically eolithic in form, but necessarily the products of natural forces, as they belong to the first phase of the Tertiary Period, the Eocene, whereas the primates from whom man derives do not appear until the Oligocene, the second phase of the Tertiary.

The supporters of eoliths are not daunted by these arguments. They point to the fact that it is possible to classify the roughly fashioned flints into perfectly well-defined types—scrapers, borers, etc.—of which the uses may readily be conjectured, this obviously pointing to purposive action and not to a fortuitous result produced by natural causes. Secondly, they

deny that similar results could possibly be produced by natural causes. Mr. Reid Moir maintains that he has demonstrated this by a prolonged course of study of natural and artificial fracture and by experiment. Where two such experts as Mr. Hazzledine Warren and Mr. Reid Moir, both of whom have devoted close study to the subject over a long period, are completely opposed, the difficulty is not one of which a solution seems hopeful, at any rate on these lines.

A REPRESENTATIVE COLLECTION OF KENTISH EOLITHS.

I am greatly indebted to Mr. de Barri Crawshay and to his son, Mr. Raymond de Barri Crawshay, by whom the photograph was taken, for this illustration, which is particularly valuable and instructive, as it shows all the types of the Kentish eoliths. It has the further interest that some of the specimens, as shown in the table below, were found by Benjamin Harrison himself and are from his collection. Of the other specimens, most have been found by Mr. de Barri Crawshay himself or members of his family. The specimens are arranged in a series ranging from the crudest form up to the Plateau type of palæolith of acute form. The index numbers are the numbers of the specimens in Mr. de Barri Crawshay's collection. The scale may be gauged by specimen No. 32, of which the dimensions are 4¼ by 2¼ in.

No.	Locality.	Index Number.	Finder.	Designation.
1	West Yoke	2717	de B. C.	Right Hollow
2	,, ,,	2669	,,	Left ,,
3	,, ,,	2566	,,	Point and Hollow
4	Chirnhams	270	L.H. de B.C.	,, ,, ,,
5	South Ash	1591	de B. C.	Reversed double Hollow
6	West Yoke	2564	,,	Double Hollow
7	,, ,,	25.2.90	,,	Pointed Pentagon
8	,, ,,	1012	Harrison	Ovate
9	,, ,,	1097	,,	,,
10	,, ,,	25.2.90	de B. C.	,, pointed
11	Maplescombe	898	Harrison	Sub-triangular
12	West Yoke	2523	,,	Ovate
13	South Ash	2106	de B. C.	Point
14	Clads	10.1.21	,,	Pointed spatulate
15	Norstead	15.3.89	,,	,, ovate
16	Halstead	839	,,	Point
17	West Yoke	1010	de B. C.	Triangular
18	Speed Gate		L.H. de B.C.	Double-ended "Diamond"
19	Jerkins	25.4.91	de B. C.	,, ,, Fabricator
20	Old Terrys Pit	2373	Harrison	Treble Hollow
21	Surrey Plateau	2342	G. L. A. S.	Crook
22	,, ,,	2353	de B. C.	,,
23	Norstead	21.2.90	,,	Split pebble
24	Clads	5.1.20	,,	"Key" Hollow
25	Speed Gate	1683	,,	Crook point Hollow
26	West Yoke	2503	Harrison	"All round" Scraper
27	,, ,,	2578	de B. C.	,, ,, Point
28	,, ,,	2577	,,	,, ,, ,,
29	,, ,,	2665	,,	,, ,, ,,
30	,, ,,	25.2.90	,,	,, ,, ,,
31	Surrey Plateau	3269	F. L.	Acute pointed Flake
32	,, ,,	13	de B. C.	,, ,, Palæolith

Eoliths in Europe

The principal sites on which eoliths have been found are situated in France, Belgium, and Britain. Of these, those for which the earliest date is claimed are situated in France and Belgium. Of the four phases or periods of the Tertiary Epoch, the later three, Oligocene, Miocene, and Pliocene, only are in question. A claim has been entered for Eocene specimens, but it has hardly been received seriously. The finds at Thenay have already been mentioned. These, which belong to the Oligocene, were at one time supposed to show signs of the action of fire. They have been rejected by one authority who, however, accepts the evidence for finds of Miocene times at Le Puy Courny, near Aurillac, in the Department of Cantal. These flints were found in a deposit of alluvial sand which overlay a marine deposit and was itself under 10 metres of volcanic debris. Extensive finds on

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the plateau of Hautes Fagnes, in the Ardennes, known as the Fagnian culture, have been the subject of careful study by M. Rutot, the eminent Belgian archæologist, whose carefully arranged and graded collection has carried conviction to more than one sceptic who previously was acquainted only with such selected implements as had been figured in M. Rutot's publications. Incidentally, in this connection it may be mentioned that those who support the eolith claim that no criterion is equal in value to the judgment which comes from the experience of handling and testing the adjustment to the hand of a large number of specimens, genuine and other. Up to the present the evidence for Miocene, and still more Oligocene, man has been regarded with considerable caution by archæologists. Recently, however, Professor W. J. Sollas, who has on more than one occasion expressed himself strongly against the human origin of many examples for which it was claimed, has examined a large collection of specimens from the Miocene deposits of Cantal, made by the late Mr. Westlake. His opinion, which was submitted to the Anthropological Section at the recent meeting of the British Association at Liverpool, is in favour of their being of Miocene date and possibly of human origin. He was, at any rate, prepared to go so far as to say that he knew of no natural forces in this area by which they could be produced. "They bear," he said, "cogent evidence of design." It may be hoped that these results will be published and made available for consideration at an early date.

Eoliths in Britain

In Great Britain eoliths have a farily wide distribution, principally in the South and East of England, the most important centres being Kent, on the chalk plateau in the area extending from Seven Oaks to the Darenth, and in East Anglia in the neighbourhood of Ipswich.

The Kentish finds occur in the red clay Tertiary drift which covers the chalk plateau, a few Pleistocene implements of recognised form occurring with the predominating ruder forms. These were first found by the late Mr. Benjamin Harrison, a life-long collector whose devotion to the study of the question of early man in Kent is worthy of the grateful remembrance of all archæologists. Specimens were submitted by Harrison to Sir Joseph Prestwich and accepted by him as of human origin in 1889, when he gave them the name of eolith. They were, however, rejected by such eminent authorities as the late Sir John Evans and Sir W. Boyd Dawkins.

Our evidence for Tertiary man in East Anglia is due largely to the indefatigable labours of Mr. J. Reid Moir, who for many years has devoted himself untiringly to the study of the prehistoric archæology of this area. Here, however, the problem is complicated by the introduction of a new type of implement of Tertiary age which Mr. Reid Moir and Sir E. Ray Lankester would distinguish sharply from the eolith. This is the rostro-carinate implement, a highly specialised type differing from the more generalised and rudimentary eolith in the peculiar shape indicated by its name, its sides converging to form a keel-shaped upper surface, while the sides and upper surface converge forward to form a beak. These specimens were found on the floor of London Clay under deposits of crag, 3 ft., middle glacial gravels, 15 ft., and later gravels, 7 ft. The human origin of these rostro-carinates has been strongly contested. Professor Sollas found a large number at Selsey Bill, but did not suggest that they were due to anything but natural causes, while Professor Boule, who examined the site personally, maintained that they did not differ from accidentally fractured fragments associated with them on the same surface.

The Foxhall Discoveries of 1920

Of the less highly specialised East Anglian types, which Mr. Reid Moir holds should be kept distinct from the Kentish eolith and for which he would prefer the name "pre-palæolith" or "pre-Chellean," the best-known specimens are those which were discovered at Foxhall, near Ipswich, in 1920. This find, which may be regarded as the culminating-point of a long series of investigations carried out by Mr. Reid Moir in East Anglia, is perhaps one of the most remarkable in the whole history of the eolithic question, not the least noteworthy of its results being the fact that it has served to convince such eminent and careful scientists as l'Abbé Breuil and Professor Fairfield Osborn, the American archæologist, that here we have indubitable evidence of man in the Tertiary Age.

Mr. Reid Moir's discovery aroused so much interest and gave rise to so much controversy that the question was taken up by the International Institute of Anthropology of Paris. An International Commission was appointed which included some of the most prominent archæologists and geologists of the day, among them M. Capitan, of Paris, M. Lohest, of Liège, M. Fourmarier, of Liège, Mr. G. Grant MacCurdy, of the American School of Archæology in Paris, Professor Nelson, of New York, and Mr. Miles Burkitt, of Cambridge. This Commission visited all the sites from which Mr. Reid Moir had obtained his specimens, and saw his collections. They also inspected collections at Cambridge, the British Museum, South Kensington,

and Mr. Westlake's collection of French implements at Fordingbridge, as well as Mr. Warren's collection of naturally fractured flints. The report of this Commission has now been presented to the International Institute and has recently been published. (*Revue Anthropologique*, 1923, pp. 53–67.)

The Report of the International Commission

The report consists of two parts, one dealing with the geological conditions of the find, the other, in part by M. Capitan, dealing with the archæological question.

The geological section, by MM. Lohest and Fourmarier, deals at greatest length with the deposits in an abandoned quarry at Thorington Hall. Here at the base of the excavation lies the London Clay (Eocene). Above this is the Red Crag (Pliocene), containing fossil shells (*Neptunea contraria*, *Pedunculus glycimeris*, *Natica*, etc.), some broken, others intact, with the two valves still joined. At the base of the Red Crag in a detritus bed including fragments of London Clay and unrolled flints, in which are found the specimens which it is claimed are the products of intentional fashioning by human agency. After a careful examination of this site, the authors of this section of the report, relying upon the appearance of the stratification and the occurrence of these fossils, which are of a type associated with Tertiary deposits, affirm that without any doubt it is undisturbed and of Pliocene age. Other sites were examined. Here, however, while deposits assigned to the Red Crag overlay Eocene sands and clays and the bed at the base produced humanly fashioned flints, in the absence of characteristic fossils such as were found at Thorington Hall, it was not considered possible to fix the age of the flints beyond question as contemporary with those deposits.

These conclusions are supported by a supplementary report by MM. Hamal-Nandrin and Fraipont.

In the report on the archæological problem M. Capitan gives the result of a rigorous test. Taking the collections of these implements, in number roughly a hundred, he rejected approximately one-half as being in any way possibly open to doubt. All rostrocarinates were included among the doubtful. From the remainder, about half were set aside as being probably of human origin ; but of the remainder, some twenty in all, he was of the opinion that there could be no doubt whatever that they were the work of man or of some subhuman percursor of man. And, indeed, several members of the Commission have pointed out that if this residue had been found among the rougher implements of a Mousterian find, no question would ever have been raised as to their human origin.

And here for the moment the matter rests. The general impression left by the report is that the question has been investigated in a thoroughly careful and scientific manner and that the report is scrupulously fair to both sides. On the archæological question M. Capitan's vast experience and his sound judgment must carry great weight. The geological evidence is beyond cavil, and until it has been possible for someone to show that on the archæological question the judgment of M. Capitan and his colleagues is at fault, this report would appear to justify the conclusion that one site at least has produced indubitable evidence of Tertiary man in East Anglia.

The Latest Methods of Determining Star Distances

By William J. S. Lockyer, M.A., Ph.D., F.R.A.S.

Director of the Norman Lockyer Observatory, Salcombe Hill, Sidmouth

A KNOWLEDGE of the distances of the stars is one of the most essential requirements of modern astronomy, and its importance in the problem of exploring and understanding the universe is fundamental.

Otherwise it would be difficult, if not impossible, to obtain any information concerning the actual brightness of the stars or their sizes, masses, densities, and other characteristics—all essential parts of any intelligent account of the universe and without which our knowledge would be wholly parochial.

Early Methods

Acting on the assumption that the brighter a star is, therefore the nearer it must be to us, the early astronomers made an attempt to arrive at an approximate acquaintance with the distances and consequent distribution of the stars in the universe. Even then no idea of their actual distances was secured, but simply their relative distances.

Observations of the stars, night after night and year by year, by means of the Transit instrument or Transit Circle led astronomers to determine the position of stars with very great accuracy. It was soon noticed that some stars changed their places owing to

the fact that they were moving comparatively quickly; it was therefore concluded that their motion was apparent because these particular stars were nearer to us, just as the motion of a man walking at a distance of a hundred yards is more easily observed than one walking at a distance of a mile. It was found that it was not necessarily the bright stars which exhibited the greatest motion, so that the assumptiom made by the earlier astronomers was proved to be untenable.

The first successful attempt to determine the distance or "parallax" of a star was accomplished by Bessel in the year 1837. He showed that the star 61 Cygni, a star of about the fifth magnitude, had a parallax of about one-third of a second of arc. This is a very small quantity to measure, but it is really large as regards the parallax of a star. The method he adopted was exactly similar in principle to the processes of surveying land at the present day. As stars are immense distances away from us, a short base-line is of no avail, so he employed the largest one possible. This consisted of a length equal to a line joining the positions of the Earth at opposite points of its orbit, that is a base line of 186 millions of miles. The process of observation consisted in determining at a certain time the exact position of the star in question and then making similar measurements six months later. The apparent change of position due to the translation of the observer gave a value of its distance. This method is known as the "absolute method" and may be considered one of the most difficult operations in the whole field of practical astronomy.

The method of "parallactic motion," which is the apparent movement of the stars due to the velocity of the solar system as a whole in space, is another means of obtaining trustworthy values of the average distance of a group of stars, though not of individual members.

At a later date another process for determining stellar distances was evolved, called the "differential method." For this the position of the star to be studied was measured in relation to neighbouring stars at different times of the year.

The application of photography to astronomical problems has greatly facilitated this method, because by photographing the star region at the specified times, the position of the star in question in relation to the other stars on the plate can be measured at leisure.

In spite of the great length of the base-line, the values of the parallaxes are so small that they are extremely difficult to measure. Very great care has not only to be exercised in the observations themselves, but every possible source of personal and instrumental error has to be taken into account and eliminated as far as possible. As the observations have to be spread over at least six months, the determination of every single parallax is a lengthy process.

The New Spectroscopic Method

In the year 1914 the spectroscope was first applied to the determination of stellar distances, and this new method, now coming into more general use, was originated and developed by Professor W. S. Adams and other astronomers at the Mount Wilson Observatory, in California. By its means parallaxes can be obtained with comparative ease and rapidity.

The spectrum of a star is obtained by passing the light of a star through a prism or train of prisms attached to a telescope. A star's light is thus spread out into a long band of light having the colours of a rainbow, extending from violet at one end through indigo, blue, green, yellow, orange to red at the other end. This band is the analysis of the light of the star and is termed its "spectrum."

Throughout this spectrum lines or bands can be observed in different parts of it, and these by their positions indicate the presence in the star of particular substances such as gases, metals, etc.

The spectra of many thousands of stars have been photographed, and, astonishing to relate, these spectra can be classified into so few as approximately fifteen different types. The type of spectrum is indicative of the temperature of the star. It is now known that stars which give gaseous lines in their spectra are hot, those that exhibit metallic lines are cooler, and those which indicate bands are cooler still.

Now the life of a star consists first in increasing its temperature or getting hotter; then a maximum temperature is attained, after which it cools and the star eventually becomes invisible. It will be seen, therefore, that if two stars have the same temperature, it is quite possible that one star may be getting hotter while the other is becoming cooler. This is a very common occurrence.

The peculiarity about stars at the beginning of their careers is that they are of great size or volume and have very small density: the older they get the smaller becomes their volume and the greater their density. Thus *young* stars are very much bigger than *old* stars, and this had led astronomers to call the former "giants" and the latter "dwarfs."

Now it is quite easy to understand that if a "giant" star and a "dwarf" star of the same temperature were placed at equal distances from us, the former would outshine the latter on account of his greater size, or in other words the "giant" would have a greater "intrinsic" brightness.

If all the stars had the same individual intrinsic brightness, then the nearer stars would be the brightest

and the most distant the faintest, and the original assumption of the earlier astronomers mentioned before would have been correct. But stars differ very considerably in intrinsic brightness. If, therefore, all the stars were placed at the same distance from the Earth, they would appear of different magnitudes, or would have, as it is called, different "absolute magnitudes." The unit of distance adopted by astronomers is that distance where the parallax would be $0''\cdot1$, and the absolute magnitude of any star is its apparent magnitude when reduced to this unit distance.

Now if the distance of a star is known, as it may be by one of the methods previously described, and if, also, its apparent magnitude is known, as is the case with most stars, then it is quite easy to determine the star's absolute magnitude.

How it is Employed

The principle on which the new method is founded is that the intrinsic brightness of a star has an appreciable effect on its spectrum. Thus, if two stars have the same type of spectrum or have approximately the same temperature, but differ greatly in luminosity, they will probably differ greatly in size, density, and in depth of their surrounding gaseous atmospheres. If this be so, then their spectra should exhibit variations in the intensity and character of such lines as are peculiarly sensitive to the physical conditions of the gases in which they find their origin, in spite of the general correspondence between the two spectra.

It has been found by Hertzsprung and Adams and Kohlschütter that certain lines in stellar spectra do give indications of variation with absolute magnitude.

An examination of these spectra shows that certain lines are more intense if a star is of great absolute magnitude than if it is of small absolute magnitude. By measuring the intensities of these lines with respect to other lines in the spectrum, it is possible to determine the true absolute magnitudes of the stars. Having obtained thus the absolute magnitude, and knowing the apparent magnitude, then the parallax can be easily determined.

The first step in the process is to have available a classification of star spectra like that previously mentioned based on detailed measurements of line intensities. Such a classification already exists and is rapidly being extended. It is next necessary to construct a series of reduction curves for each type or class of spectrum, or for small groups of types. These curves are based on the calculation of absolute magnitudes of stars from known data such as the apparent magnitudes, and the trigonometrical parallaxes and the relative intensities of selected pairs of lines carefully measured.

Having now formed these curves, it is then a simple matter to measure the intensities of special lines in any star spectrum and determine the star distance.

Naturally greater accuracy is obtained when more than one photograph is examined and several pairs of lines in them are used, but this involves very little extra labour.

The rapidity with which the determinations of parallax can be secured, when once the fundamental curves are formed, is far in excess of that of the older methods.

The large powerful telescopes of the present day are capable of photographing the spectra of very faint stars, so that a rapid survey of the whole heavens, at any rate to stars of about the seventh magnitude, will be accomplished in the near future.

Any observatory that possesses a large number of stellar spectra can utilise them for this purpose.

A little more than a year ago the spectroscopic determinations of stellar parallaxes were confined entirely to the United States, at the Observatories of Mount Wilson and Harvard College. The Astrophysical Observatory at Victoria, B.C., has recently proposed to work up their spectra in this research.

In this country the only observatory that has been and still is occupied with this work is the Norman Lockyer Observatory at Sidmouth, but the Director of the Stonyhurst College Observatory has recently announced his intention of taking up this subject.

At the Sidmouth Observatory the parallaxes of 500 stars have already been determined and published by the Royal Astronomical Society, and another similar number will soon be completed.

An interesting point in connection with this observatory's work is that the measurements of the intensity differences between pairs of lines are being made by a method, originated by the writer, which is different from either of those used at the American observatories. Thus a comparison between the American and Sidmouth values is of special interest.

This opportunity may be taken to point out the valuable assistance which was given by the Department of Scientific and Industrial Research which rendered possible the undertaking of this research on so large a scale.

SCIENCE, PHILOSOPHY, AND RELIGION

In an age such as ours, when men are striving to extract some meaning out of the confusing experiences and impressions of life, the need for books explaining in a popular yet authoritative way the relative values of science, philosophy, and religion, and the manner in which these three separate branches of human knowledge and mental and emotional activities can be brought to bear on the past, present, and future problems affecting mankind, is very great. We think that this need is well supplied by a new *Library of Philosophy and Religion*, edited by Dr. W. Tudor Jones, the first three volumes of which have recently appeared—*Metaphysics of Life and Death*, by Dr. W. Tudor Jones; *Buddhism and Christianity*, by Dr. J. Estlin Carpenter; and *Aspects of the Study of Society*, by Mr. R. T. Evans. (Hodder & Stoughton, Ltd., 3*s*. 6*d*.)

Modern Industries—VI

Salts, Brines, and Alkalis

By R. C. Skyring Walters, B.Sc., Assoc.M.Inst.C.E.

Salts—their Distribution and Composition

The salts that are distributed over the globe give rise to many industries, some great, some small, and several large volumes would be required to describe adequately the geological, metallurgical, chemical, mechanical, and economic considerations upon which such industries are based. Here, however, a few typical industries are outlined to show as simply as possible, firstly, the complexity of the problems connected with the formation of the raw materials, and, secondly, the complexity of the problems involved in their conversion into finished products for the use and convenience of man.

Without going into statistics, we all know sodium chloride, or ordinary common salt, is one of the most widely distributed of the salts in nature, in which state it is called rock-salt. It is also probably the salt most used by man, not only directly for flavouring and preserving food, but indirectly for the manufacture of alkalis, washing-soda, and soap. Salt, Geikie states, occurs in rocks of all ages, in the pre-Silurian rocks of the Punjab, in the Silurian of America, in the Carboniferous of Australia, in the Permian and Trias of Germany and England, in the Tertiary of Poland and France, and is being formed at the present day in the salt-lakes of Utah, the Dead Sea, and in the desert of Kirgis Steppe in Siberia.

In England, salt is usually associated with the Red Keuper Marl of the Trias series. These rocks mould the scenery of a large portion of central England. The hard red sandstone beds generally form conspicuous hills, and the marl and clay beds, the low-lying ground around them, and the floors of valleys in between. In Cheshire the Keuper Marls, which contain the salt-beds, are some 3,000 ft. thick, and were all originally deposited in water; the sands and clays being the settlement of the muds of the ancient seas washing against ancient land cliffs, or of muds brought down by rivers draining the ancient land-surfaces; the rock-salt (and other things) being the chemical precipitation of certain substances originally in solution, which have separated out owing to certain physical conditions prevailing at the time.

In these seas and sediments several materials existed, in solution or as solids; a few of the salts may be noted thus: Salt (Sodium Chloride), Carnallite (Potassium and Magnesium Chloride), Calcium Chloride, Sodium Sulphate (Glauber's Salt), Kainite (Potassium and Magnesium Sulphate with Potassium Chloride), Gypsum (Calcium Sulphate), Celestine (Strontium Sulphate), Natron or Washing-soda (Sodium Carbonate), Potassium Carbonate, Magnesite (Magnesium Carbonate), Chalk or Limestone (Calcium Carbonate).

It would take too long, however, to explain, even if it were possible, how these several substances, at one time more or less in solution, came to be crystallised out so as to form the solid deposits on the earth's crust as we now see them. The conditions for crystallisation of more than one substance in the same solution is very complicated. If one substance only is in solution the case is simple, as the water can only contain so much of that one substance, and if excess of that substance is added, it remains undissolved. But if two substances are dissolved in the same water—for instance, salt and gypsum—and the water is evaporated, some of the gypsum will crystallise before the salt. Thus seams of gypsum are sometimes found below seams of salt. If five or six different substances are in a solution, it is found not only that some crystallise out before others, but that some combine, forming double salts which have each its own rate of crystallisation. Again, some salts dissolve others; thus while pure water dissolves 254 parts per 100,000 of gypsum (Calcium Sulphate), strong brine dissolves 719 parts per 100,000, and, to complicate matters still further, certain of them cannot exist together in solution at certain *temperatures*.

How is Rock-salt Formed?

An idea of the possible origin of rock-salt, however, may be easily gleaned in the following way: Let the reader imagine a lake or sea with one inlet and one outlet for water. Now as salt is distributed in nature in small quantities and is soluble in water, water which flows into the lake carries salt with it; thus, water that has flowed over vegetation will bring in about 2 parts per 100,000, spring-water about 4, and even rain-water about ·36. These waters, with a minute quantity of salt dissolved in them, flow into the lake, and carry with them silt and mud which, in depositing, forms a bed of clay or marl. When this process has taken place the inflowing water stops and the *water* in the lake is evaporated, possibly by a tropical sun, and as the salt dissolved in the water does not evaporate, the proportion of salt in the water continually increases as the latter is being evaporated. This is comparable to what goes on in a steam-boiler. The solution becomes more salty than the sea (that is, more than 2 to 3 per cent. of salt) until strong brine containing 26 per cent. of salt is formed. Now let us see what happens when the evaporating process is continued upon the brine-solution. The brine is not able to dissolve any more salt; if any salt were put

into this brine it would not be dissolved; conversely, if more water is evaporated and taken away from the brine, salt will crystallise out and will be deposited as a bed of rock-salt. And last of all this bed comes to be preserved for all time by a bed of clay, through which fresh water cannot penetrate to redissolve the salt; this bed of clay is formed from sediment from the fresh-coming water. This fresh water probably very largely travels over, without disturbing, the heavier brine. (A gallon, or ·16 cub. ft., of water weighs 10 lb., whereas a gallon, or ·16 cub. ft., of brine weighs 12 lb.) We may therefore imagine this process being repeated through untold ages, for the deposits are upwards of 4,000 ft. thick: wet seasons being represented by marls, clay, or sandstone seams; and dry seasons, by rock-salt seams.

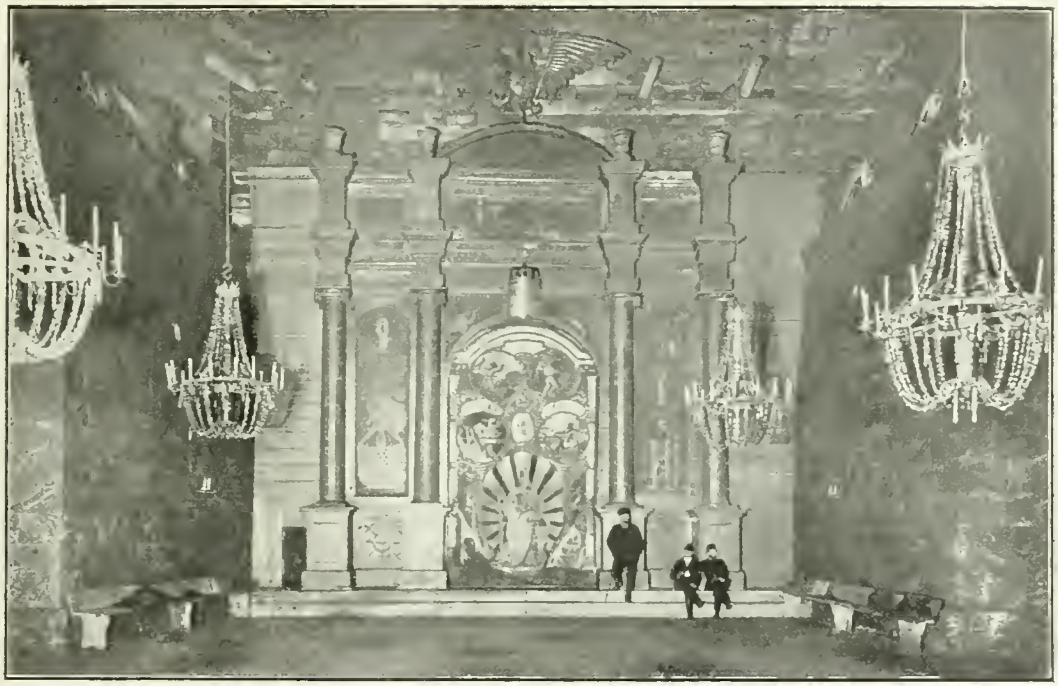


Fig. 1.—Wieliczka Salt Mines, Galicia.
The beautiful Francis Joseph Ballroom, made of salt. The chandeliers are made of polished salt crystals.
(By courtesy of Sir Isaac Pitman & Sons, Ltd.)

In England rock-salt appears in beds of 1 in. to 100 ft., of various colours; the red being due to oxide of iron; the green, to chloride of copper; the blue, to silicate of copper. It contains several other impurities —clay, sand, bitumen, gypsum, Calcium and Magnesium Chloride (the latter being responsible for its deliquescence, i.e. its capacity for absorbing moisture). There are cavities that are filled with brine and various gases. Fossils are sometimes embedded in it. Gypsum is often found in layers of various thicknesses; thus at Stassfurt there is a bed of pure rock-salt 685 ft. thick, with thin layers of Anhydrite (gypsum without water), a quarter of an inch thick, at intervals of 1 to 8 in. throughout the bed. At this place also other salts—Carnallite, Kieserite, Polyhalite—occur in thick beds. In France there is a rich deposit of Potassium Chloride associated with rock-salt, which is known as sylvinite. Most of these salts have been preserved by clay-seams in the manner indicated, but other salts, such as those that are only very slightly dissolved by water, are found at the surface, an example being Celestine, which occurs in patches in the Trias in Gloucestershire.

How is Rock-salt Obtained?

Rock-salt-winning is a very ancient industry. In olden times it was obtained from the sea, by leading the sea into shallow lagoons and evaporating the water by the heat of the sun, thus imitating on a small scale the natural process of the formation of a rock-salt bed. This method is pursued in several parts of the world at the present day, notably in China. The actual mining of rock-salt is carried out on a large scale in several parts of Europe, for example at Wieliczka, near Cracow, in Poland. Here the underground galleries have a length of some 65 miles; some of these are converted into show-places for visitors and lighted by electricity, provided also with houses, churches, ballrooms, restaurants, lakes, bridges, and even railway stations. Fig. 1 gives a view of the Francis Joseph Ballroom, everything, including the chandeliers, being composed of salt. It may be noted *en passant* that

salt is twice as strong as bricks in compression. It will be readily understood that no water whatever has any access into the workings, which attain the considerable depth of 12,000 ft. below the surface. In the past disasters have occurred owing to the influx of underground waters into the mines.

In England, down to 1850 most of the rock-salt deposits in Cheshire and Worcestershire were mined; as such mines one by one became flooded, brine-pumping was resorted to, and at the present time, salt in England is almost entirely obtained from brine. The overlying clays are so punctured that fresh surface-water has now had access to the beds of rock-salt, in which are sunk several bore-holes. The brine is usually lifted by an air-lift which forces compressed air to the bottom of the bore-hole; then the force of the compressed air rising to the surface lifts the brine. Fresh water probably finds its way through salt deposits in underground channels which are continually being enlarged owing to the dissolution of the salt by the fresh water travelling through them; occasionally the brine appears to be over-pumped, i.e. its level in the bore-hole sinks considerably; this is attributed to the underground channel in the rock-salt being temporarily blocked by a collapse of the clay-roof above the rock-salt. But when the brine-level in the bore-hole is lowered, a greater hydrostatic pressure is put on the brine, which thereby usually cuts another way through to the shaft and so returns to its normal level. Naturally, considerable damage occurs at the surface in subsidences with all this disintegration and dissolution going on underground, at a depth of not very much more (in many places) than 150 ft., and damage to property in the district occurs from time to time.

Manufacture of Salt

There are several processes of extracting the salt from the brine; one very recently adopted is known as the Hodgkinson process. In this the brine is pumped into a large enclosed pan, 30 ft. in diameter, which is heated by the hot gases from a mechanically stoked furnace. The temperature of the hot gases is so controlled that the crystals of salt can be varied in size; either very small crystals can be made for table-salt or large lumps for salting and packing fish. There are two other smaller secondary pans in which table-salt is produced, and the gases pass on to four large rectangular open pans 60 ft. by 25 ft. where coarse crystals only are made, a slower rate of evaporation and crystallisation taking place in these pans. By this process about 7 tons of salt are produced to every ton of coal consumed, and the finest table salt is produced without grinding the larger crystals. In the older process (of evaporating brine in open pans with the furnace in contact with the pans), only 2 tons of salt were produced per ton of coal, and finer varieties of salt had to be obtained by grinding the coarser crystals. The extraction of the salt by this process and the use of the air-lift in pumping the brine, instead of the expensive method of quarrying rock-salt, has revolutionised the industry.

Rock-salt and Public Water-supplies

It must be said, however, that the quarrying of rock-salt, providing that the workings could have been kept dry at all times, had the great advantage of being under control, the roofs being propped up and not allowed to fall in. With brine-pumping, subsidences occur, but nobody knows where or when they are going to take place. The whole of the top-water in the strata of the district is becoming, to say the least, brackish. Wells have to be abandoned and both public and private water-supplies are becoming affected. In the immediate future big problems may have to be solved by local authorities, to cope with the question of water-supply, since several large towns have wells in proximity to this salt region. Moreover, brine may travel many miles through the adjacent porous sandstones of the Keuper, Bunter, and strata of more or less porous deposits of glacial-drift-gravel which now fill up pre-glacial valleys. Such brine or brackish waters may appear again in most unexpected places. It may be noted that Sodium Chloride, which is so very easily dissolved by water, is exceedingly difficult to extract from water, and it is only by evaporation that it can be so extracted. This would be quite impracticable in any water-works; even on board ship it takes 1 lb. of coal to render a gallon of sea-water fit for drinking by repeated evaporation and condensing, and even then it is not very palatable.

Alkali

In some places, therefore, bore-holes have been sunk some distance away from the rock-salt beds, by the makers of alkali. In other places brine is conducted in pipes, as from the Northwich district to the alkali-makers at Runcorn. Salt is necessary for the manufacture of washing-soda (which in turn is used for the manufacture of soap and many alkalis) either by the Leblanc or the ammonia-soda process. In the former, brine is treated with Sulphuric Acid, and thus Sodium Sulphate is formed. This substance is converted into Sodium Carbonate, or washing-soda, by being treated with Carbon Dioxide and lime. In the ammonia-soda process (which is cheaper), ammonia is added to brine, which is filtered and cooled and passed into towers and Carbon Dioxide is caused to bubble through them. The crystals of washing-soda which form are dried by heat, while the by-product, Ammo-

nium Chloride, is heated with lime to regain the valuable ammonia so that it may be used again. Calcium Chloride, which is formed in turn, is again probably heated, Professor J. M. Thomson states, to extract the valuable chlorine by a secret process.

Sylvinite

In Alsace, near Mulhouse, there are some interesting deposits of a mineral salt known as Sylvinite, which is mined on a large scale, now, by the French. This mineral is the source of the valuable potash-fertiliser, and contains 35 per cent. of Potassium Chloride associated with rock-salt. This occurs at a depth of 1,600 to 2,300 ft. The deposits, like those in Cheshire, form an ellipse with the longer axis running north-east to south-west, that is to say that the deposits attain their maximum thickness along this line, and thin out to the north-west and south-east of it. Sylvinite exists in two beds of 3 ft. to 8 ft. thick (locally up to 17 ft.) belonging to the Tertiary period. The roof in the mines is formed of hard clay, which renders the workings watertight. The horizontal layers of the salt are coloured in most beautiful shades of red, blue, and yellow, probably due to different percentages of salts which have separated out in the old salt-lake. The concentration of the Potassium Chloride is effected by immersing the Sylvinite in boiling Sodium Chloride brine, which dissolves Potassium Chloride only. This solution is gradually cooled for two or three days, when the Potassium Chloride crystallises out while the Sodium Chloride still remains in the solution as brine, which is used again to treat a fresh supply of Sylvinite. The Potassium Chloride crystals are subsequently dried. Towards the end of the war, an artificial process of extracting Potassium Chloride from the flue-dust from blast-furnaces was instituted for the manufacture of high explosives.

Celestine

A unique but small English industry is that of Celestine-digging. This salt occurs in the Trias at the surface at Yate, in Gloucestershire, and this is the only important deposit in the British Isles. Its commercial value lies in the fact that it contains 90 per cent. of Strontium Sulphate, which is converted into Strontium Nitrate (by Nitric Acid) for the manufacture of fireworks and red flares. Also, another substance made from it, Strontium Hydroxide, attained by roasting the sulphate with coal and iron ore, is used for separating sugar from beet-molasses.

The small white crystals of Celestine are found in masses 2 ft. thick in the red marly clay at a depth of 2 ft. to 10 ft. below the surface. In Sicily, where there are large deposits, these crystals are coloured blue, a fact which gave rise to its name. The deposits are discovered by probing the clay with large iron rods until they strike the stone. A pocket or layer is thus

FIG. 2.—WIELICZKA SALT MINES, GALICIA.
The railway station on the third level.
(*By courtesy of Sir Isaac Pitman & Sons, Ltd.*)

found and a pit is dug, which gets so large that pumping often has to be resorted to. The Celestine, being comparatively soft, is then picked out by hand, cleaned and stacked in neat square heaps; some 20,000 tons before the war were exported annually to Germany; now the bulk of it goes to the United States. Associated with the Celestine, gypsum sometimes occurs, appearing as a pretty pink, opaque crystallised substance. No systematic method of working has been followed, and the ground is left full of pits and mounds which render it practically useless.

The writer wishes to record his thanks to Messrs. Sir Isaac Pitman, Ltd., for the loan of the photographs showing the ballroom and a railway station in the Wieliczka Salt Mines.

Plant Breeding

By I. B. N.

SYSTEMATIC botanists have marshalled all known plants into divisions and subdivisions of which the "species" is generally the ultimate. But the great total of 140,000 recorded species does not adequately represent the diversity of the plants. Only eleven species of wheat are recognised, but they embrace about 3,000 different kinds or "forms." There are forms with tall straw and forms with short; red grain and white grain forms; early and late ripening forms, and so on in each species through a vast range of differences. New forms of cultivated plants may be introduced into a locality in a variety of ways. They may be brought in from elsewhere; occasionally they arise in nature by processes to be described later; and they can be made from old ones by hybridisation—that is to say, by breeding from two distinct species. They are not always better than the old forms, and careful tests of their merits must be made before they can be recommended for general cultivation. All methods of obtaining and testing forms of crop plants new to a locality constitute the science of plant-breeding.

Scientifically the plant-breeder must try to be "Jack of many trades and master of his own." Like the geneticist, or student of heredity, he must study the laws of transmission of characters from parents to offspring. The geneticist may study those plant characters which are easiest to observe or of greatest scientific interest, but the plant-breeder must deal with those which are of agricultural importance. Of these, in general, the most vital is yielding capacity, the average amount of useful produce furnished per acre. Now the eye is no judge of such a plant attribute as this and definite measurement is essential. We may suppose that a new form of barley has been produced and it is desired to test its yielding capacity in comparison with an old form. If a one-tenth-acre plot of each form of barley were grown, the plots being side by side, and the new gave 15 per cent. more grain than the old, there would appear to be convincing evidence of superiority. But experiment has shown that, if instead of one pair of plots many such pairs are grown, the difference between the forms is not constantly 15 per cent. It fluctuates, and may even sink to zero on some pairs. This inconstancy is attributable to a number of causes. The soil may not be equally fertile on both the plots of a pair; sparrows may damage one plot of a pair more seriously than the other; the incidence of a fungoid disease may similarly be heavier on one plot than another. Actual test shows that a difference in crop between two adjacent one-tenth-acre plots cannot be regarded as significant unless it exceeds 20 per cent. Present-day crops in England have reached a level which makes a sudden yield improvement of 20 per cent. almost inconceivable. An improvement of 2 per cent. is much more probable, and small as this seems, it would, if effected in all the cereal crops of England, increase their annual value by £1,000,000 Methods of detecting such small yield differences have, by degrees, been evolved. The principle is to grow about twenty small plots of every form under test, arranging them so that every form has a plot in every part of the total area of ground employed. Then, if one end of the area be particularly fertile, all forms share the amenity; and correspondingly all forms would suffer together in a part infested by wireworm. The Chess-board Method, as this system is called, permits of the certain detection of differences of 2 per cent.

Other agricultural characters vie with yielding capacity in importance and difficulty. Resistance to disease in potatoes, the bread-making quality of wheat, and the suitability of barley for good beer are examples. Often, not to create, but to appreciate the merits of new forms, is the essence of the problem, and it is impossible to understand either the difficulties or the achievements without a knowledge of the complexity of the agricultural characteristics of plants.

Ornamental plants offer problems demanding an eye for the beautiful and an understanding of popular prejudices. The profusion of forms of tulips, primulas, daffodils, carnations, violas, orchids, and many others, which annually astonish us at the shows of the Royal Horticultural Society, are mainly the favoured survivors of great numbers of new forms raised by hybridisation. It is far easier to gauge the opinion of the gardening public upon a new flower than the value to housewife and farmer of a new potato.

Novelties True and False

"Selection" has been a fertile means of improving crop-plants. It consists in examining single plants in a field, picking out any that appear to be different from the familiar forms, and then making accurate tests when a sufficient bulk of seed has been obtained. The progenies of the original single plants should be kept separate. Chinese cultivators of 3,000 years ago had the germ of the modern selection idea. Some more or less chance selections have proved of great merit. In 1824 a herd-boy, Sandy Thomson, took home an oat-plant he found growing on a heap of ditch mud. His master multiplied the stock and the "Sandy" oat was for many years unrivalled on poor soils in the North. Chevallier barley, perhaps still the best-quality barley and grown in every good barley country, sprang from a progenitor found by a Suffolk vicar in a labourer's garden. But with these stimulating examples a warning must be given. Not infrequently, an unusually fine plant of an old form is hailed as "new" by the undiscriminating or unscrupulous. To this we owe the plethora of synonymous names so familiar in potatoes, cereals, cabbages, and most other crops. The law protects both the name and the manufacture of a flea-powder or a mouse-trap, but offers no obstacle to the theft and renaming of any form of crop-plant. Reputable seedsmen condemn the practice, but it profits the dishonest, for a novelty—the latest pea or potato—sells at a premium. An unwitting purchaser often pays a high price for a form of wheat or other plant which years ago, under its old name, he has tried and rejected. Slender and obscure differences may separate two forms, and proof of identity of the same form under two or three names calls for great critical ability. Recently, samples of different named forms of potatoes were examined by the Potato Synonym Committee of the National Institute of Agricultural Botany. No less than 17 per cent., all bearing different names, were proved to be the familiar form "Up-to-date," and 5 per cent. more were "King Edward." From this auspicious beginning it is hoped that synonym elimination may be extended to all our crop-plants.

Immediate benefit is unlikely now to accrue from the introduction of foreign forms of cereals into England. Unadapted to our climate, they rarely thrive, but although the farmer could not profitably grow them, they may yet have their value. "Little Joss" wheat was bred by Professor Biffen from a Russian wheat of very low yielding capacity, but which was immune to attacks of yellow rust. He crossed it with Square Heads Master—a good cropper, but susceptible to rust—and Little Joss represents a combination of immunity to rust, high yielding capacity, and other valuable characteristics. As far as his resources permit, the plant-breeder ransacks the crops of the whole world for forms possessing features of outstanding merit.

The Importance of Hybrids

In hybridisation lies the great hope of crop improvement. By its means from existing forms new can be derived, and a valuable character, even if associated with others which are undesirable, can be transferred from that association to a different one. The attractive history of hybridisation begins with Joseph Gottleib Kölreuter, who about 1750 first demonstrated that seed-formation was a sexual process and effected the first artificial hybridisation. His successors improved the technique and amplified the field of work. Towards the end of the eighteenth century Thomas Andrew Knight raised great numbers of new forms of plants, including garden peas and the fruits. Two brothers, John and Robert Garton, founders of the present seed firm, Gartons, Ltd., commencing in 1890, produced a great succession of new forms of cereals. But the greatest of the pre-Mendelian plant-breeders was William Farrer. To benefit his health he went to Australia after going down from Clare College, Cambridge, and originally as an amateur, devoted himself to wheat-breeding. Most of his predecessors optimistically clung to the belief that from continual hybridisation, especially with widely different parents, there must emerge some wonderfully superior novelty. With an insight which gave him an appreciation of one aspect of Mendel's then dormant discovery, Farrer perceived that valuable forms could be bred only from parents themselves possessing specific desirable characters. Choosing his parents from Europe, India, and America, he systematically aggregated into new wheat forms the characters requisite for the diverse conditions of Australia. His great services have their monument in the present wheat-growing industry of the Commonwealth.

The Secret of Successful Breeding

Mendel's discovery, like Kölreuter's, opened a new chapter of history and, since modern plant-breeding is based upon it, it deserves our respectful consideration.

A seed is formed from two small bodies called reproductive cells or gametes. One of these, the male gamete or pollen grain, is from the male organs of the flower; the other, the female gamete or ovule, is from the female organs. A pollen grain, entering and combining with an ovule, brings about the conversion of the ovule to a seed. To hybridise or make a cross between two parent plants, it is necessary to remove the male parts of the flower of one of them and to place upon the untouched female parts some pollen from the

other. To keep out wind- or insect-borne pollen from other plants, the flower which has been thus treated must be covered with fine muslin or a greased-paper bag. The seed resulting from this act of artificial hybridisation grows into a plant called the F_1 (first hybrid generation). This, by fertilising itself, produces seeds, and these grow into plants collectively called the F_2 generation. From the seed of every F_2 plant a family of plants (F_3) may be raised. The original parents are designated F_0. That the form of the F_1 and the proportions of different forms in F_2 were governed by precise laws was the essence of Mendel's discovery.

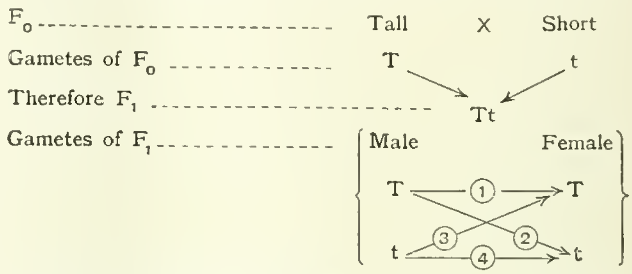
In 1866, just before he became Abbot of the Augustinian house at Brünn, Mendel communicated his discovery, actually made in 1859, to a local scientific society and by letter to some botanical contemporaries. All failed to appreciate his work: the *Origin of Species* published in 1859 had still a monopoly of biological attention. Fortunately in 1900, through a brief reference in a book, the discovery was unearthed. It was immediately confirmed and enthusiastically received. Mendel had died sixteen years previously. His laws may be thus briefly stated.[1]

All plant characters are in pairs, the members of a pair corresponding to the presence and absence of a Mendelian "factor." In garden peas tallness and shortness are such a pair. The F_1 plant from the cross Tall × Short is found to be tall. Consequently tallness is said to be the "dominant" character and shortness the "recessive." The dominant character results from the presence in the plant of the factor for tallness, the recessive from its absence. From the seeds formed (by self-fertilisation) by the F_1 plant, there develop a number of plants (called the F_2 plants), some tall and some short, there being 3 talls to 1 short, i.e. a proportion of 3 : 1. Of the 3 talls, 1 (i.e. a third of the total number of talls) breeds true, all its progeny being tall. The remaining 2 talls, when self-fertilised, behave exactly like the F_1, their progeny being in the proportion 3 talls to 1 short. The shorts of the F_2 breed true for shortness (i.e. their progeny consists solely of short plants). Thus the F_2 falls into three types:

1 tall (breeding true); 2 tall (giving tall and short in their progeny); 1 short (breeding true).

The proportion 1 : 2 : 1 remains constant however often the experiment is repeated. This constancy is the first salient feature, and Mendel's laws afford an explanation of it in the following terms:

The tall parent (F_0) introduced the factor T for tallness, while the short parent (F_0) lacked it. Absence of the factor may be denoted by t. When the gametes of the F_0 plants combined, they formed a seed of constitution Tt. From this the F_1 plant grew, having, of course, the constitution Tt. Mendel argued that of its gametes, male and female alike, exactly a half possessed the factor for tallness (to be denoted therefore by T) and the other half lacked it (denoted by t). When it became self-fertilised by the union of its own male and female gametes, the two types of male gamete must have combined with the two types of female gamete, giving four types of seed. Thus T male with T female = TT seed; T male with t female = Tt seed; t male with T female = Tt seed; t male with t female = tt seed. The seeds formed by F_1, and thus the F_2 plants into which they grew, must therefore be expected in the proportion 1 TT : 2 Tt : 1 tt. Of these F_2 types TT will breed true on self-fertilisation, since it can contribute only T to all its gametes, male and female. Similarly the tt must breed true. But the 2 Tt will, like the F_1 (also Tt), give a 1 : 2 : 1 ratio in their progeny. This prediction accords precisely with the experimental result described above. A diagrammatic representation may be given.



(The arrows indicate the different possible combinations of male and female gametes.)

$$\text{Therefore } F_2 = \overset{(1)}{TT} + \overset{(2)}{Tt} + \overset{(3)}{Tt} + \overset{(4)}{tt}$$
i.e. 1 TT : 2 Tt : 1 tt.

Plants of constitution Tt which, when self-fertilised, do not breed true, but in their progeny "split" off different types, are called "splitters." In botanical language they are "heterozygous" for T; forms like TT and tt are "homozygous."

Crosses in which the parents differ in more than one pair of characters illustrate Mendel's second law—pairs of characters are inherited independently of one another. Suppose that in the cross discussed the tall parent had "round" seed and the short had "wrinkled." Round and wrinkled may be denoted by R and r, for experiment shows that they are a pair of characters and that round is the dominant. To foretell the results of the cross, it is simply necessary to apply the principles explained for T and t above jointly to both pairs of characters. All possible types of gamete will be formed in equal proportions and all possible combinations of male and female gametes

[1] *Heredity*, by L. Doncaster, Cambridge Manuals of Science and Literature, is a simple and attractive little book for those who seek further information about Mendelism.

will take part in the formation of seed. Simple mathematics enable the following scheme to be drawn up:

A Cross between Two Parents which differ in Two Pairs of Characters.

F_0 . . .	Tall, Round seed	×	Short, Wrinkled seed	
Gametes of F_0 .	TR		tr	
Therefore F_1 . . .	TtRr			
Gametes of F_1 .	Male: TR, Tr, tR, tr		Female: TR, Tr, tR, tr	
Therefore F_2 =	TTRR*	TTrr*	ttRR*	ttrr*
	2 TTRr			
	2 TtRR	2 Ttrr	2 ttRr	
	4 TtRr			
	9 :	3 :	3 :	1
Containing	T and R	T but not R	R but not T	Neither T nor R.
Therefore	Tall and Round	Tall and Wrinkled	Short and Round	Short and Wrinkled

Here the ratio of forms in F_2 is 9 : 3 : 3 : 1 and is always the same for this cross. For T and R independently the ratio is, as before, 1 : 2 : 1, e.g. forms with RR : forms with Rr : forms with rr = 4 : 8 : 4 = 1 : 2 : 1.

The forms marked * are the only ones homozygous in both pairs of characters, and therefore they alone will breed true to both. Of the remainder some, e.g. TtRR, are homozygous for one pair and one, TtRr, for neither. For crop production only true-breeding forms are acceptable, i.e. forms homozygous in all character pairs, for they alone will remain unchanged. The forms of ttRR and TTrr are completely homozygous and are different from both the parents (F_0). They are thus examples of new forms from old ones. Where the F_0 differ by 3, 4, . . . pairs of characters precisely the same principles apply, and it will now be realised how, by choosing suitable parents, we can theoretically synthesise any desired combination of characters.

There are two great limitations to this alluring theoretical possibility. Plants will not intercross at random. Generally, different forms of the same species present no difficulty. But we often desire to combine the characters of two different species. The attempt has many times been made. In some cases no hybrid seed is formed; in others an F_1 plant is obtained but, like the mule, is sterile; in yet others the F_1 produces some seed, but most of it fails or develops into sterile F_2 plants. It seems improbable that new and improved crop-plants will be obtained from inter-species crossing, but many forms of violas, saxifrages, roses, irises, and pinks have been obtained in this way, while among the orchids even inter-generic crosses have succeeded. Strange to say, wheat and rye are partially inter-fertile.

"Linkage" is a phenomenon which imposes the second limitation to the welding together at will of plant characters. This in effect is a tendency of two pairs of characters to cling together, so that in the F_2 of a cross there is not the uniform assortment of character combinations which was described above for unlinked characters. Certain combinations may appear in F_2 only in the proportion of, say, 1/1,000 or even not at all. Linkage is an exception to Mendel's second law which he himself never encountered.

Mendelism and the Farmer

The British farmer grows many plant forms of hybrid origin. He does not always realise this, and when confronted with an admitted product of methodical hybridisation often asks, "Will it hark back?"—i.e. will it in time revert to the form of its less valuable parents? If the work has been well done, if the new form is homozygous in all characters, the answer is an emphatic No. Such a form, if protected from foreign pollen, will continue to breed true. Plant forms, whether natural or derived from artificial hybridisation, homozygous in all characters to start with, and safeguarded from natural cross-pollination, are called "Pure Lines." Being immutable, they cannot be improved by selection. For a hundred years past, and even to this day, time and effort have been vainly spent in attempts to improve pure lines by selection. The most common fallacy has been that the continued selection year after year of the largest seeds must "improve the type." But careful experiment has shown that if, year after year, the largest and the smallest seeds of the crop of a pure line are separately selected and grown, the resultant plants are the same. Commercial stocks of seed often contain five or six different pure lines, and selection will separate these out but can do no more. Catalogues often expatiate on "Jones's re-selected variety." At the best this can only be a stock free from admixture with other forms. Such a stock is valuable, but not always to the extent of the enhanced price demanded.

The immutability of the pure line has one exception. Among the most carefully safeguarded stocks may be one or two plants different from the type. They are called "mutations," and arise from the original form by some as yet inexplicable process of nature. Mutant buds occur on some trees and may be propagated by budding on to a suitable stock. Mutations are exceedingly rare, and accidental admixture of seed or natural cross-pollination is not infrequently the cause of their reported occurrence.

In many minds the comparative simplicity of the

fundamentals of Mendelism obscures the complexity of the plant-breeder's task. He chooses two parents for their desirable characters, crosses them, and endeavours to secure from the progeny a form which combines the best features of both. In a simple case he obtains an F_2 of, say, 1,000 plants without much difficulty. Parents differing in four or five pairs of characters will give a considerable diversity of types in F_2, and in all probability there will be a number of more recondite parental differences which escape observation and reinforce the complexity of the inheritance. By what tests may the best forms be detected? Will the form which excels as a single plant still be the best when millions of its descendants are grown crowded together in the field? Are the best-seeming forms homozygous in all characters? These are the inevitable puzzles. Judgment and experience can alone attempt to solve them. As yet, unaided, pure science cannot assess the agricultural characters of plants, particularly of single plants. In principle it would be quite simple to sow the seed of every F_2 plant and thus obtain an F_3 family, and from this the F_4, F_5 . . . could be grown. In every generation there is increased material on which to base judgment. This is all to the good, but increase in material means increase in ground-space and, above all, in time and attention. To prevent the accumulation of impracticably great numbers of plants—and a single plant of wheat may in five years give rise to 100,000—elimination must begin early and become more intense in the successive generations. When some twenty forms remain, a chessboard trial of yield is conducted, tests of other characters—e.g. of baking quality in wheat—are made, and usually only one form is finally retained. This is tested against well-known forms on a field scale, and if found to be an improvement on them, is placed upon the market. The production of a really satisfactory form on these lines must occupy not less than ten years, and fifteen is the probable number. Many new forms are brought to market with inadequate testing in a far shorter period. They enrich the producer—as do most "novelties"—have their short day, and disappear. Others follow in monotonous but profitable succession: the farmer is the victim.

It is well known that the F_1 plant may in some cases be far more robust than either of its parents. This so-called "hybrid vigour" is a complex phenomenon and may be displayed only in height and abundance of foliage, there being little or no seed produced. But ingenious minds, arguing from these cases that the act of artificial hybridisation is responsible for increased "vigour," have conceived a new procedure. Two plants of precisely the same form, and which normally would produce seed by self-fertilisation, are artificially crossed. From seed so obtained there grow plants called "regenerated" plants, and from these stocks of "regenerated seed of existing forms" are placed upon the market at enhanced prices. Such "regeneration," if a real phenomenon, is at present unknown to science. It is noteworthy that in a careful test of the yielding capacity of a form of wheat from ordinary seed, and from seed "regenerated" in the manner described, there was absolutely no indication of yield increase through "regeneration."

"England's premier wheat" (or cabbage, etc.) is the recommendation sometimes bestowed on a form newly marketed. It is misleading. Our country, small as it is, has many different soils, and is afflicted by great annual climatic variations. No plant form, among the common crop-plants, is every year, and in every place, better than all the others. Instead of claiming or attempting to breed this master-form, the aim must be to ascertain as closely as possible the special environmental features of the different parts of the country and to find or breed the plant forms best adapted to them. Of the known forms of wheat, barley, potatoes, etc., none is better than all others in every part of England, and in a single county one form may excel in the east, a different one in the west.

The Berber Tribes of Morocco

By E. Gurney Salter, Litt.D.

"The world is a peacock, Morocco is its tail."

So runs the native proverb, voicing the naïve patriotism of those to whom "the world" probably means at most Moslem North Africa, from east to west. But, indeed, Moghreb-el-Aksa, the "farthest west" portion of this world, with its natural beauty and rich endowments, stirs the enthusiasm of European visitors, now that the motor and the aeroplane are invading its secular inaccessibility.

In descriptions of the triumphant progress of French colonisation in the Protectorate, or of the recent severe reverses suffered by the Spaniards in their northern zone, allusion is frequently made to "the tribesmen" of Morocco, or tribes are mentioned by name. Raisuli's stage-bandit career is nearly as well known as Captain Macheath's.[1] But, in general, ideas about these tribes are rather vague, and it is hoped that the present article may throw a little light on some characteristics of the Berbers, who are quite the most interesting, as well as the enormously preponderating race in the

[1] Those readers who have witnessed the recent revivals of *The Beggar's Opera* and *Polly* will be well acquainted with this delightful villain.

country. In some districts they have become more or less completely fused with Arabs and Arabic is spoken as well as the Berber tongue, or has even superseded it, but in others the primitive race and tongue still persist.

The remaining peoples of Morocco (other than European settlers) may be briefly summarised as follows: the Arabs, descendants of Arab invaders in the eleventh and following centuries; the Moors, a name that, strictly speaking, should be confined to the mixed population, largely Berber in origin, of the ports and other towns who are descendants of the Moors expelled from Spain; the Jews, who live in a ghetto (*mellah*) in certain towns, and travel about as traders, interpreters, etc.; they are despised, rather than actually ill-treated; the negroes, formerly imported in great numbers from the Sudan as slaves; and the *harratin*, a negroid race, varying from brown to black in colour, possibly half-castes, possibly a distinct race, who are largely employed as agricultural labourers.

FIG. 1.—A WAYSIDE SCENE.
(By courtesy of the French Protectorate Government in Morocco.)

The Berbers themselves are in origin essentially a white, Mediterranean race, with whom a brown Saharan race would appear to have mingled. They are often deeply bronzed by the sun, and black-haired; north of the Atlas, e.g. in the Rif, a distinctly fair type is found, with reddish hair and blue or grey eyes. Some Berbers in the south-west of Morocco are as black as negroes, and are rather despised by the others in consequence. The Moroccan Berbers are, of course, akin to the famous Tuaregs and to some Algerian tribes (e.g. the Shawiya). They call themselves Imazighen (= noble), and the name of their language (*Tamazight*) is derived from the same word. They are a virile race of fine physique; fanatical lovers of liberty, casual in religious observance (when they take up arms it is far more in defence of their independence than as a "holy war" against the infidel), but appallingly superstitious; shepherds and agriculturists, scorning trade. They have democratic institutions peculiar to themselves, of which we shall speak later.

Three main groups of Berbers may be distinguished in Morocco: (1) the *Ruafa*, or tribes of the Rif, i.e. the eastern portion of the Spanish zone along the Mediterranean; these of old furnished the redoubted "Barbary pirates"; they speak a dialect of Tamazight known as *Tarifit*, or in some parts as *Zenatiya*; (2) the *Shluh*, of the western or south-west districts (the Sus, Southern Atlas, Marrakesh, etc.), speaking another of its dialects called *Tashilhait* (arabic, *Shilha*), and often Arabic also; (3) the *Beraber*, of the Middle and High Atlas, extending northward to the Franco-Spanish frontier and southward to the Tafilelt,[1] with outlying groups in the west. Their dialect is known as *Taberberit*. The Beraber are the most formidable and numerous group of Berbers, and the least arabised or subdued. Several of their tribes have not yet made their submission to the French. They do not form a political unit, though there are two or more powerful confederations of tribes among them; the unifying factors are their language and central position. Very few Jews are found in their territory.

Each of these groups consists of a great number

[1] This is the Berber form of the name of the famous date-palm oasis, in Arabic, *Tafilalet*.

of tribes (*kebila*),[1] which, in their turn, have innumerable clans or divisions, and subdivisions. There are leagues among tribes (*leff*) and alliances of groups or factions within a tribe (*soff*). Estimates as to their numbers vary so greatly and are based in many cases on such insufficient evidence that they are hardly worth quoting. Many of the Atlas tribes are as yet very little known. The French are collecting statistics, and are encouraging the study of Berber dialects and folklore. Tamazight is little used for writing purposes, the Berbers being mostly illiterate ; the Arabic alphabet is employed. The education and development of the Berber and mixed Berber-Arab tribes offers the best hope for the future of Morocco, the local Arabs being more or less effete, and decadent. Arabic influence in the country has been chiefly shown in the spread of their language and religion, and the introduction of the hosts of sherifs (*shurfa*), or descendants of the Prophet, of whom the Sultan himself and Raisuli are both representatives. These sherifs enjoy an enormous prestige, and often wield considerable power. A notable example is that of the sherif clan of the "sacred city" of Wazzan, heads of the Tuhama Confraternity. The position is so much coveted that some Berbers, ignoring their non-Arabic birth, have laid claim to it !

Equally venerated is the *marabut*, or holy personage, male or female, sometimes the founder of an Order, or religious house (*zawiya*) ; sometimes an ascetic or ecstatic, a miracle-worker, or simply a madman. The word *marabut* is also applied by local Moroccan usage to holy places and things, such as shrines, tombs of saints, trees, or even heaps of stones.

The Berbers, who apparently adopted Islam in easy-going fashion, are equally easy-going in its practice. They are for the most part uninstructed in the Koran, and disregard its precepts as to prayers, ablutions, and fasts. Even Ramadan is ignored. Boar's flesh is eaten, and a liquor manufactured by the Jews from grapes or figs is drunk, not, however, to excess, sobriety being the usual rule among Berbers. Many traces of pre-Islamic superstitions are found ; they live in terror of demons, spirits, werwolves, and the like. Talismans are worn, and local saints are invoked, against these, the Kadriya Confraternity being considered specially efficacious in exorcisms. Most males in Morocco, Berber or Arab, are enrolled in one or other of the various Confraternities, or Orders ; these cannot be discussed here, but it may be remarked that they were not political in origin, though they have often been diverted to political ends. The Shluh of of the Sus district have a great reputation as sorcerers. The Ihahen (Arabic, *Haha*), a large Berber tribe, or rather group of tribes, on the west coast, cherish a firm belief in a mascot. A certain individual, or family, known as *anflus*, must necessarily take the lead in any tribal undertaking, whether a journey or a battle, if success is to follow. Great prestige attaches to the post.

A regular ritual is observed among the Berbers in connection with agriculture and the promotion of fine weather, with marriage and other family events.[2]

Any allegiance that the Berbers have yielded to the Sultan (there has been remarkably little trace of it) has been to his religious position. In his political capacity, he and his government, the Maghzen, have been consistently defied. The Shluh round Marrakesh have proved relatively amenable, but, everywhere else, Berber territory has been emphatically *bled-es-siba* (land of gunpowder, i.e. rebellion). The tax-collector has returned empty-handed, or not returned at all, while short work has been made of any *kaid* or *sheikh* whom it was sought to impose on a tribe from outside. There is a rude proverb somewhat to this effect : "A strong tribe can soon spit out a *kaid*." With certain exceptions, to be noted later, the *kaids* of the Berber tribes have very little power ; some of the wilder mountain tribes are said not to tolerate them at all. The Berbers are, in fact, notably independent and democratic ; three of their most interesting features are their codes of customary laws, their government by a popular assembly, and the position allotted to women among them.

The popular assembly (*anfaliz* ; in Arabic, *jemaa*), has all the real power in its hands ; it decides all the affairs of the tribe—peace, war, alliances, markets, and so forth. It consists of all the males of fighting age ; the voice of the elders (*amghar*) carries great weight, and women are also called into consultation. One elder is chosen annually to execute the decisions of the council and is known as the *amghar-el-aam*. Great jealousy is felt lest any power should become hereditary. In time of war, the Beraber call together a general assembly of delegates from all their tribes, one of whom is elected as dictator (*amghar afella*)—his powers, again, being strictly limited to one year.

The Berbers are monogamous, and fond of their children and homes. Women, though hard-worked, are respected and consulted, and go about freely. Marriage is more or less of a sale, but sexual morality is higher (especially among the Ruafa and Beraber) than among the surrounding Arabs. Women have the privilege of affording protection (*anaya*) to suppliants in danger of their life. A safeguard, usually known as *zettat*, is also given to travellers passing through the territory of one tribe, or into that of an allied tribe, or clan, while some powerful tribes protect weaker ones in return for tribute. Certain tribes are also

[1] Singular ; so also the two following Arabic words.

[2] See Westermarck's books on these subjects.

recognised as the special protectors of holy places, but this does not prevent their looting them when funds run low! The Ait[1] Atta, for example, the most redoubtable Beraber confederation, not long ago sacked the "sacred city" of Tamgrut, on the Draa, which was under their ægis.

The exceptions referred to above as to government by *kaids* are the four great kaidates of the Atlas—Glawa, Gundafa, Mtuga, and Menaba—with some others on the western coast. These Atlas *kaids* remarkably resemble mediæval barons, and rule their peoples in feudal style. The two first, who are much the most important, dwell in crenellated fortresses of striking architecture, unlike other buildings in Morocco, possibly Phœnician in origin. They are only nominally viceroys of the Sultan, really independent, and all-powerful in their part of Morocco. The heads of the Glawa have been loyal allies of the French, and the chief maintainers of order in the south in troubled times. Among the other *kaids* having more than usual power are those of the Abda and Ihahen (*Haha*) tribes; the jealous rivalry between two *kaids* of the latter involved their clans, not long since, in protracted warfare.

Martial Prowess

The Berbers make fine soldiers, daring, skilful, and capable of endurance. They have proved formidable antagonists for European troops, alike in their own land and on the fields of France and Flanders. For many years, in spite of attempts to stop them, they have been smuggling in European arms (e.g. Gras and Martini rifles) and gunpowder, to supplement or supersede their native-made flintlocks and powder, their primitive curved daggers and billhooks. Whole villages or tribes have clubbed together to buy rifles, and regular firing-practices are held. During the Great War, to the discredit of Spanish neutrality, German arms and military instructors were allowed to pass freely through the Spanish zone—an action which has recoiled on the heads of the ill-fated Spanish troops in the late campaign. On several occasions in the past, the tribesmen have only yielded to heavy artillery, but some of them have apparently now captured and learnt to use this themselves. The Berbers are skilled in cavalry tactics, and in sieges and ambushes; they are good shots at short range, and have, naturally, a great advantage in their intimate knowledge of the difficult country in which operations are carried on.

It must, unhappily, be recorded that, with all their fierce courage, they are also cruel, treacherous, and vindictive, and so greedy for loot that they will plunder their own fallen comrades. Avarice is, indeed, somewhat surprisingly, one of the chief vices of the Berbers. Inter-tribal or inter-divisional hostilities are frequent; the possession of coveted watering places is fought for, or the hidden granaries (*silos*) of enemy tribes raided and their villages destroyed.

FIG. 2.—AN OLIVE PRESS.
(*By courtesy of the French Protectorate Government in Morocco.*)

[1] *Ait* is a Berber collective term, equivalent to the Arabic *Beni*, or *Ulad*, i.e. children (or people) of . . .

Agricultural Pursuits

The Berbers exhibit every stage of pastoral life, nomad, semi-nomad, and sedentary. They own enormous flocks and herds (sheep, cattle, camels, and in the south, ostriches), and vast palm-groves in the Tafilelt. Many of the coast tribes are fishermen. Most of the Shluh tribes lead sedentary lives, and are great cultivators, their land being very fertile. The rich black soil (*tirs*) of the western districts bordering on the Atlantic produces, even with primitive agricultural methods, three, or as many as four, crops a year, while the grains of corn on each spike have been known to average eighty or more. The cattle of the Zaer and Zayan tribes of this region are famous. When scientific methods of farming and cattle-breeding have been more widely spread by colonists, there seems no limit to the results that may ensue; the true wealth of Morocco may probably turn out to be here rather than in its alleged mineral resources.

In this same district (western Morocco, south of the River Tensift), and peculiar to it, is found the argan-tree, or "Barbary almond" (*Argania sideroxylon*); and the tribesmen extract an inferior oil from the kernels of its fruit. Olives and walnuts, vines, figs, and other fruit-trees are cultivated along the river-banks; the mountain villages are pink with almond in spring, almonds being one of Morocco's chief exports, and olive-oil one of the few manufactures of the Berbers.[1] The magnificent cedars of the Atlas have, unhappily, suffered greatly from unskilful hacking by the natives. Patches of beans, peas, onions, and other vegetables are grown wherever possible, vegetables, with maize, forming the staple article of food. Meat is rarely eaten, and eggs, for some reason, are shunned! Seasonings, such as pepper and spices, are beloved, and the favourite drink is weak tea overflavoured with mint or sugar.

The men wear the *jellaba*, or loose, hooded wrap, with the toga-like *haik*; women also wear the latter, under a simple length of cotton wound round and round them, known as *lizar*. Red or yellow leather slippers are usual. In the western Atlas, a short, dark woollen wrap, ornamented with orange or scarlet, is worn. Blue cotton clothing (*khent*) is universally worn in the south. The dye from this comes off on unwashed bodies, hence the name, "the blue men of Mauretania," given to a band of religious agitators, who for some years created disturbance in western Morocco from south to north. Berber women are addicted to wearing heavy earrings, and in many tribes both they and the men are tattooed.

The nomads live in tents grouped in villages, the settled villagers either in houses of stone or pisé, or in huts of earth and branches. The tent village is called *duar*, the ordinary village *deshra*, or, if fortified, *ksar*. Each village usually has a fortified depôt (*tighremt*) for arms and grain; except among the Shluh, where such depôts are tribal, and are known as *agadir* (plural *igudar*). Such is the origin of the world-famous port, storm-centre of the 1911 crisis! (Its full name is Agadir Ighir, i.e. the fortified place on the hill.) Many of the villages are called after the weekly market (*suk*) held in them—a most important feature in tribal or sub-tribal life, inasmuch as they offer occasions for spreading news, fostering risings, or the like. These markets are held on different days of the week. Thus, to take one instance, an important centre in one tribe is known simply as Jemaa Entifa, i.e. the Friday market of the Entifa. There are also several well-known annual fairs, attended by all the tribes round; these have sometimes a semi-religious character.

To these villages and these clusters of tents the French administration, inspired by Lyautley, is gradually bringing order and civilisation. Native schools are established and medical succour afforded by travelling doctors and dispensaries. Tribal customs are, where possible, respected, and tribal administration preserved, under supervision. The happy results of this "peaceful penetration" are already so evident that it may be hoped the system will be copied by Spain in her zones of occupation. Without losing any of their fine qualities, but rather developing them to the full, the Berbers must be taught to live at peace among themselves; on them hangs the well-being of Morocco.

[1] Others are rough pottery and leather-work

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Among the Stars

A Monthly Commentary

A Famous Modern Astronomer

Much of the recent progress in astronomy is associated with the name of Dr. Harlow Shapley, Director of the Harvard College Observatory, Cambridge, Mass., U.S.A., who has within the last few years attained to one of the highest positions in the scientific world. A few biographical notes concerning this distinguished astronomer are therefore not without interest. Dr. Shapley is a native of Nashville, Missouri, where he was born on November 2, 1885. In 1907 he entered the University of Missouri, where he took the degrees of A.B. and A.M. In 1911 he proceeded to Princeton in order to follow the study of astronomy, and during his three years' period of research in the University there he came under the influence of Professor H. N. Russell, and in 1914 graduated Doctor of Philosophy. In 1914 he joined the staff of the Mount Wilson Observatory, and in the same year commenced his monumental *Studies based on the Colours and Magnitudes in Stellar Clusters.* These investigations, of which the results are summarised in the contributions from Mount Wilson Observatory, dealt not only with clusters, but with the structure and extent of the visible universe, the distances of various classes of celestial objects, and problems of cosmogony. In 1921 Dr. Shapley was called to Harvard to succeed Professor E. C. Pickering as Director of the famous Harvard College Observatory. Since his marriage in 1914 he has had the invaluable assistance of Mrs. Shapley, who is herself a distinguished astronomer.

The Distribution of the Red Stars

One of the latest of the numerous important circulars issued from Harvard under Dr. Shapley's inspiration deals with the distribution of the red stars. These stars were ranked by Secchi in his famous classification as of the third type, and in the Draper Catalogue they are known as Class M. The class is divided into four sub-classes, M*a*, M*b*, M*c*, and M*d*, and of these the M*d* stars are the long-period variables. "Practically all the Class M stars in the Henry Draper Catalogue," says Dr. Shapley, "are giants. This conclusion can be reasonably deduced from what is now known of the relative frequency of giants and dwarfs among stars brighter than the ninth magnitude. The high luminosity of these stars is also evident from characteristics of their spectra." The distances of the "invariable class M giants," as Dr. Shapley calls the typical red stars, are easily computed when the apparent brightness is known; and from the relation between apparent magnitude and distance, it is possible to fix the positions in space of four thousand red giants. Of the stars brighter than the eighth magnitude, Dr. Shapley finds that stars of the sub-class M*b* show no concentration to the galactic plane, i.e. are scattered equally over the sky, while the M*a* stars are more numerous by 30 per cent. per unit area between galactic latitudes -10° and $+30^\circ$ than elsewhere. For stars fainter than the eighth magnitude, both classes M*a* and M*b* are strongly aggregated towards the plane. This is a highly important result indicating that the fainter stars belong to the Milky Way clouds, while the nearer stars are more or less members of the local cluster. Dr. Shapley also finds that stars fainter than the eighth magnitude are much more numerous in the direction of Sagittarius than in the opposite region of the sky. This may be due to the better quality of the plates used at Arequipa—the southern station of Harvard College Observatory—for photographing the southern skies. "But it may be largely explained by the greater real depth of the Milky Way in the direction of Sagittarius. The greater frequency in that direction is already established for planetary nebulæ, novæ, and other types of highly luminous stars." In the case of the long-period variable stars of class M*d* it has been found that in the direction of Taurus there is but one-half the average number, and in the direction of Sagittarius there is twice the average number; while the fainter stars of the other three sub-classes are much more numerous in the same direction. These results are strongly confirmatory of Dr. Shapley's theory of the structure of the Stellar System, and of his contention that our Solar System is near the centre, not of the general galactic system, but of a local cluster, and that the real centre of gravity of the whole system lies amid the dense star-clouds of Sagittarius.

The Light Changes of Beta Ceti

It will be remembered that in the end of February last, Mr. Abbot, a young Englishman resident in Athens, announced that the star Beta Ceti had suddenly increased in brilliance. At the time of the announcement, the constellation Cetus was becoming rapidly invisible in the sunset twilight, and confirmation was difficult to obtain. In a paper published in the *Monthly Notices* of the Royal Astronomical Society, however, Professor A. D. Ross, of Perth, Western Australia, states that his observations under excellent meteorological conditions clearly indicate an increase in brightness. "There can be no doubt," he maintains, "that a remarkable disturbance took place in the star prior to March 1." The brightness decreased steadily until March 4, "after which there appear to be fluctuations with a period of about five days." Beta Ceti has never been known to be other than a normal, steady star, and this sudden outburst is extremely puzzling. The star is situated at a considerable distance from the galactic plane, where outbursts of the kind are relatively frequent. The spectrum of the star is of Harvard type K: that is to say, it is a yellow star, not very dissimilar to the Sun in physical condition.

The Recent Solar Eclipse

Astronomers have been much disappointed by the reports from the various expeditions sent out to observe the total eclipse of the Sun on September 10 last. Professor Campbell states that the Lick Observatory Expedition was frustrated by a densely clouded sky throughout the whole period of totality. Fifteen other expeditions

in California and Mexico experienced similar misfortune. One party located in Central Mexico was more successful and was able to observe a portion of the total phase.

HECTOR MACPHERSON.

Reviews of Books

Botany. A Junior Book for Schools. By R. H. YAPP, M.A. (Cantab.), Mason Professor of Botany in the University of Birmingham. (Cambridge University Press, *3s. 6d.*)

All who are interested in the teaching of Botany to beginners should make a point of securing a copy of this excellent book. It is admirably suited to the purpose for which it was written; in particular the clear and careful original drawings, and the well-thought-out scheme of practical work, deserve mention. The standard is that of the Junior Local Examination of the University of Cambridge. R. J. V. P.

Essays of a Biologist. By JULIAN HUXLEY. (Chatto & Windus, *7s. 6d.*)

Mr. Julian Huxley is not only the inheritor of a famous name; he also possesses gifts of style and skill in presentation of his arguments that were the hall-mark of his famous ancestor. He has a deep interest in the borderlands of science and philosophy, biology and theology which were always fascinating his grandfather and brought him into sharp contact with leaders of thought in his day. DISCOVERY cannot follow the author into his discussions with theologians who have much to say on the conclusions he has reached. There is less misunderstanding nowadays than there was half a century ago, and it is well to have laid down clearly that a "law of nature is not something revealed, not something absolute, not something imposed on phenomena from without or from above; it is no more and no less than a summing up, in generalised form, of our own observations of phenomena; it is an epitome of fact, from which we can draw general conclusions." Our "laws of nature" are entirely dependent on our knowledge of the facts of nature, and we can claim no finality for these laws. Conclusions drawn from laws have in their last resort to appeal to facts to verify them. Science, when it goes beyond facts and deals with processes and ultimates, has to call in the aid of philosophy and theology, and we excuse ourselves from dealing here with the great questions that are raised by our author in his concluding Essays. They have their weight coming from a man who has carefully studied the subject, but they are by no means universally accepted by scientists. Theologians reject them even when they are men of scientific attainments, and philosophers are not of one mind on them.

In his *Essay on Progress* Mr. Huxley breaks a lance with Inge and Bury, who deny the existence of a law of progress. We think that they are not so much in disagreement as may appear. Has the mind of man in historic times increased its capacity to achieve more with the material at hand than in the past? We have seen the Golden Age of Athens and its fruits have never been surpassed, and the fact that man has capabilities greater than those beings lower in scale of evolution does not imply that man possesses the further capability of progress which would prove the contention of our author. Here we have to make the usual induction of facts from which a law of progress has to be deduced, and it is at least an open question whether Inge and Bury are not as right in their view as Mr. Huxley believes himself to be in his. Closely connected with this Essay is the following paper on *Biology and Sociology*, in which he shows not only the difference but the natural connection between pure biology and sociology. Man is capable of ideas and of transmitting his ideas to such an extent that "the experience of Moses, Archimedes, or Charlemagne, of Jesus, Newton, or James Watt is modifying our behaviour to-day."

The paper on *Bird Mind* is fascinating and attractive. Mr. Huxley acutely observes and as delightfully describes his observations. The pages describing the courtship of the Grebes may be placed, without suffering in comparison, by the side of Maeterlinck's famous passages on the Bees, and here we have Mr. Huxley at his best. *Sex Biology and Psychology* contains sound criticism on many current theories, and we are glad to read his protest against the indiscriminate use of psycho-analysis. *Philosophic Ants* bases a series of reflections on the Ant-republic under the influence of heat. We have already referred to the concluding papers, which are *Rationalism and the Idea of God* and *Religion and Science: Old Wine in New Bottles*, and we take leave of a suggestive and informing volume by quoting its closing words: "That moulding of matter by spirit is, under one aspect, Science; under another, Art; under still another, Religion. Let us be careful not to allow the moulding forces to counteract each other when they might co-operate." To do this it is necessary to understand the limitations of Science, Art, and Religion. T. J. PULVERTAFT.

Practical Plant Ecology. A Guide for Beginners in the Field Study of Plant Communities. By A. G. TANSLEY, M.A., F.R.S. (*7s. 6d.*)

This book is intended "as a guide for those who are attracted to ecological work, but are uncertain as to how to set about it." The study of plants and animals as they exist in their natural homes or, as the author happily puts it, the investigation of their household affairs—that is what Ecology means—is a branch of biology which has made rapid progress in recent years, and many botanists have devoted themselves to this difficult and fascinating pursuit. One difficulty has been the lack of a satisfactory guide. Formerly botanical excursions were mainly devoted to collecting and naming plants and searching for new localities: we have now gone beyond that stage. Ecology does not supplant systematic botany; a basis of sound systematic knowledge is essential; but the ecologist must also be a plant physiologist. His aim is to learn as much as possible about the actual life of a plant, why it grows in one place and not in another, why certain plants usually grow together; in short, he sets himself the task of going to the root of the matter, not

only in the literal sense of inquiring into the relation between the root-system of plants and the ground from which they obtain most of their raw material, but in a figurative sense. His aim is to learn all that is possible about the manifold factors which govern the life, the wanderings, and the interrelations of the component elements of vegetation.

In Part I the author explains what Ecology is ; he draws an apt comparison between ecology and the study of man : "It is not sufficient to study the structure of his dead body in the dissecting-room and the functions of his organs and tissues in the laboratory. To learn what man actually is and does in the world, we have to go out into the world and study him as he lives and works among his fellows. And the same is true of plants." Ecology is concerned not only with natural vegetation, but with vegetation that has been in a greater or less degree interfered with by man. In Part II the reader is introduced to Plant Communities, the Plant Association, the Succession of Vegetation, and other subjects. The next step is to learn how to make an ecological survey of a tract of country ; a primary, or extensive, survey must be followed by a more intensive study of the detailed problems of vegetation. The author wisely emphasises the problems which need only simple methods ; he writes primarily for the beginner. Part V is devoted to ecological work in schools. Nature Study as taught in some schools has little or no educational value. As Mr. Tansley says, many teachers substitute "facile and largely inaccurate generalisations for observation of nature and sound deduction," instead of training the pupils to observe "the facts of nature as they are, and then to go on to find out as far as possible how they came to be so."

The book is neither cheap nor beautiful, but it is full of sound advice clearly given ; it is written by a botanist exceptionally well qualified by experience and by the prominent part which he has taken as a pioneer of plant ecology in this country to speak with authority. Mr. Tansley's book may be confidently recommended to teachers, as also to those for whom botanical inquiry is a hobby and not a profession. A. C. SEWARD.

Philosophical Studies. By G. E. MOORE, Litt.D. (Kegan Paul, Trench, Trübner & Co., Ltd., 15*s*.)

In this volume Dr. Moore collects together ten papers on various philosophical topics, written at various times eight of which have been previously published, mostly in the *Proceedings of the Aristotelian Society*. All the papers, he tells us, are printed without substantial change The best known of these papers is the *Refutation of Idealism*, which appeared in *Mind* in 1903, in which Dr. Moore claims not only to knock the bottom out of Idealism, but also to have detected a "self-contradictory error" which "no philosopher has ever yet succeeded in avoiding." Dr. Moore now says : "This paper now appears to me to be very confused, as well as to embody a good many down-right mistakes." It is a pity that he did not at least add a note to tell the reader where he thinks he has gone wrong. The author himself should be called on to review this paper.

All the papers except two, which are ethical, are concerned with that set of problems usually called the Theory of Knowledge, which occupied the main attention of the classic writers from Descartes to Kant and have never to this day been laid to rest. Dr. Moore is an acute and careful writer, and on all the problems he touches he has some good point to make. He is, however, rather timid and over-cautious. He is always laudably anxious to define precisely the question he wishes to answer—so much so that he sometimes approximates to the method caricatured in one of the Bab Ballads, which spends so much time on explaining what is not its subject that it never reaches a subject at all. He is also—less justifiably in our opinion—very anxious to isolate the question, and in particular to discuss it apart from any wider metaphysical bearings it may possess. This is often annoying, especially when the author brushes these questions aside with an airy, "I do not know whether . . ." One jumps to the classic retort, "Sir, you are *paid* to know !" The distressing frequency of italicised monosyllables and of the parenthetical "I think" are minor symptoms of this weakness, and sometimes give the impression of affectation.

But, if these are defects, they are the defects of qualities : nowhere is precision more valuable and more difficult to attain than in philosophy. If Dr. Moore could only persuade his thought to move on rather more generous lines, suppressing some of the more verbal niceties, he might produce work very much more impressive than anything he has yet written. In the meantime students of philosophy will welcome these collected papers on their own merits. J. L. S.

The Children of the Sun : An Inquiry into the Early History of Civilisation. By W. J. PERRY. (Methuen & Co., 18*s*.)

Mr. Perry's inquiry into the early history of civilisation owes much in its method to the late Dr. Rivers, a debt which the author fully acknowledges in his preface. But the line of investigation which Dr. Rivers followed in attacking the special problems of Melanesia is here developed to such a degree, and applied with boldness and originality to so wide a range of subject, that it may be regarded as striking a new note in anthropological investigation.

Professor Elliot Smith, to whom this volume is appropriately dedicated, and Mr. Perry, as is generally known, are the protagonists on one side of a struggle which has been going on for some time in the world of anthropological study. While it is generaly recognised that the culture of man throughout the world presents certain common features, the opinion current among anthropologists generally is that these common features are mainly, though not always, the result of an independent evolution conditioned by the common mental, moral, and physical constitution of man and his method of reacting to his environment. Professor Elliot Smith, however, influenced by his study of the early Egyptians and their civilisation, has advanced the view that these common elements are due to a diffusion of culture from

one centre, and that centre is Egypt. One of the first cultural features to which the theory was applied was that of mummification, which he pointed out occurred in New Guinea in a form identical in a number of respects with that employed in ancient Egypt, yet not such as was likely to be developed independently. The theory was also advanced as an explanation of the distribution of megalithic monuments (which Professor Elliot Smith derived from the Egyptian *mastaba* or tomb), and certain cultural features associated with them. Mr. Perry then pointed out that this distribution coincided with the occurrence of gold and other precious or useful metals and of pearls, and suggested that those who were responsible for the diffusion of the megalithic culture were pioneers in search of these objects of value to early man.

This part of Mr. Perry's theories has been somewhat severely criticised, and it has been pointed out that the coincidence is not always exact.

In an earlier volume, *The Megalithic Culture of Indonesia*, Mr. Perry has studied the distribution of the culture-complex of which the Megalith is the most prominent feature in one special area. In this work he has extended his inquiry to cover the whole area of North America, Oceania, Indonesia, and India. Taking these areas as one whole, the problem they present to Mr. Perry is this: They contain many communities of a lowly culture which, in some areas, have not advanced so far as agriculture, and yet they also possess traces of an ancient and relatively high civilisation. Mr. Perry's method of solving the problem has been to study the data for evidence of a succession of cultures, and by comparison to trace their modification in the presence or absence of certain features. In other words, he has applied the method of the geologist, who in studying stratification looks to the presence or absence of certain fossils, and of the archæologist, who in excavation establishes his sequence dates by the presence or absence of typical implements, tools, or weapons.

As a result of his comparison on these lines, Mr. Perry has satisfied himself of the existence of an archaic civilisation in the areas he has under consideration, of which the characteristic features, among others, are agriculture by means of irrigation, the use of stone for megalithic monuments and tombs, pottery-making, and the use of polished stone implements. Mr. Perry, however, does not confine himself to material culture, and by further analysis shows that the archaic civilisation also implied a ruling class of two divisions, the dual organisation which is a characteristic feature of so many primitive peoples, a sun cult, a Mother Goddess, human sacrifice, totemism, and exogamy. Not all these features are to be found in every area in which the archaic civilisation is to be found, for fission was a characteristic of this culture, and the separating body did not necessarily carry with it or perpetuate all the features of the culture.

As to the origin and means of diffusion of the archaic culture, Mr. Perry suggests a migration of adventurers whom he calls "The Children of the Sun," adventurers whose wanderings were actuated by their *desire*—an important point in Mr. Perry's theory of archaic psychology—to find and control the sources of supply of raw material for weapons and implements and of precious objects, gold and pearls, valued in the first instance for their magical properties.

The source of this archaic civilisation Mr. Perry holds to have been ancient Egypt, and he pictures the process of the gradual building up of civilisation until its completion by about the time of the VIth Dynasty. Hence it spread gradually until it reached Central America and gave rise to the remarkable civilisation of that area about the beginning of the Christian Era.

In this somewhat summary account of the scope of Mr. Perry's book it has not been possible to do full justice to the care with which he has analysed a vast mass of material, the extent of which may be gauged from the fact that his list of authorities runs to twenty-two pages. Tribute must also be paid to the skill with which he has applied the principles which Dr. Rivers formulated as the result of his Melanesian investigations on the disappearance of useful arts, in his theory of degradation as applied, for instance, to the elucidation of the culture of North America.

Mr. Perry has a skilful knack of meeting and anticipating explicitly or implicitly possible objections to his theories. However they may stand the fire of criticism after mature consideration, and however they may need modification owing to the results of further research, there can be no question that they will have a permanent effect in the development of anthropological method and theory.

Interfacial Forces and Phenomena in Physiology. By PROFESSOR SIR WILLIAM M. BAYLISS, F.R.S. (Methuen & Co., 7*s.* 6*d.*)

The fundamental interdependence of the various branches of Natural Science is to-day admitted as a theoretical proposition, but is only too frequently left out of consideration in the arrangement of courses of scientific study. In the concluding sentence of the Herter Lectures, delivered in New York in 1922, and since published under the above title, Sir William Bayliss bewails the lack of adequate preliminary training in general science in the English student of physiology. The whole book may serve as a text to this theme, for it is full of examples, not only of the great importance of physical and chemical principles to the proper understanding of physiological processes, but also of the inadequacy of our present knowledge of the interrelations of these three subjects. Admittedly the chemical doctrine most required by the physiologist is itself in its infancy (the very name of "colloid" was only invented in 1861), but one feels that if more physiologists had, like Sir William Bayliss, the determination to base their work on sound physico-chemical principles, and if more physical chemists realised the enormous field open to them in physiology, it would be to the enormous advantage of both sciences.

In discussing first the physics and chemistry of surface phenomena, and then the manifestations of these in the

living cell, Sir William Bayliss gives an interesting and well-balanced survey both of what is known and of the many gaps in our knowledge. Many of his individual statements will, as he admits, be controverted by other physiologists, notably his views on the relation of hæmoglobin to oxygen. Sir William Bayliss maintains, as is well known, that the observed facts are best explained by the assumption that oxyhæmoglobin is an adsorption compound, in apparent opposition to Hill and others, who consider it to be a "chemical" compound to which the law of mass action applies. But may not the opposition be more verbal than real? The modern tendency is to minimise the distinction between "chemical" and "physical" forces, and it is practically certain that adsorbed substances are attached to the adsorbents at definite "points" of their molecular structure. If we assume one point of attachment per hæmoglobin molecule, and that all the hæmoglobin molecules are accessible, then we shall have an "adsorption compound" in stoichiometric ratio, whose dissociation would be expected to follow the mass action law.

Quite apart, however, from its importance as an exposition in simple terms of the author's views on this and other problems, the book will be of value to physical chemists and physiologists in indicating in what directions co-operation is most needed, and in encouraging that open-mindedness and breadth of view which is characteristic of Sir William Bayliss's scientific attitude.

D. C. Henry.

Sidney Ball. Memories and Impressions of "An Ideal Don." Arranged by Oona Howard Ball. (Oxford: Basil Blackwell, 10*s.* 6*d.*)

Lack of space forbids us to write as long a review of this book as we should like. Sidney Ball did more than any other "don" of his generation to convert Oxford University from the narrow views of a single class and to place it in touch with the progressive ideas that were growing up outside it. Undergraduates who went to St. John's College will remember him with affection and veneration, and many persons outside his university, well known and unknown, will carry the inspiration of his personality through their lives. The biography has been admirably arranged by Mrs. Ball and contains impressions, among others, by Sidney Webb, Sir William Ashley, Professor Gilbert Murray, and Dr. Farnell.

E. L.

ERRATUM

The price of *An Introduction to the History of England*, by Mr. (not Dr.) C. R. L. Fletcher, reviewed in our last number, should have been given as 9*s.*

Books Received

SCIENCE

The Mechanism and Physiology of Sex-determination. By Richard Goldschmidt. Translation by W. J. Dakin, D.Sc. (Methuen, 21*s.*)

The Geology of the Metalliferous Deposits. By R. H. Rastall. (Cambridge University Press, 21*s.*)

Principles and Practice of Wireless Transmission. By G. Parr. (Ernest Benn, Ltd.)

Newer Aspects of the Nutrition Problem. By F. Gowland Hopkins. (Oxford University Press, 1*s.* 6*d.*)

Journal of Scientific Instruments. Vol. 1, No. 1. (The Institute of Physics, 2*s.* 6*d.*)

The Genesis of Petroleum. By Percy Edwin Spielmann, Ph.D., B.Sc., etc. (Ernest Benn, Ltd., 5*s.*)

The Properties of Matter. B. G. McEwen, M.C., B.Sc. (Longmans, Green & Co., 10*s.* 6*d.*)

Founders of Oceanography and Their Work. By Sir Wm. Herdman, C.B.E., D.Sc., F.R.S. (Edward Arnold & Co., 21*s.*)

Relativity. A Systematic Treatment of Einstein's Theory. By J. Rice, M.A. (Longmans, Green & Co., 18*s.*)

Practical Chemistry for High Schools. By H. B. Dunnicliff, M.A., B.Sc. (Macmillan & Co., 5*s.*)

Statistical Method. By Truman L. Kelley, Ph.D. (Macmillan & Co., 18*s.*)

Practical Physical Chemistry. By Alexander Findlay, M.A., Ph.D., D.Sc. 4th Edition. (Longmans, Green & Co., 7*s.* 6*d.*)

The Expert Witness. By C. A. Mitchell, M.A., F.I.C. (Cambridge: Heffer & Sons, Ltd., 7*s.* 6*d.*)

British Hymenoptera. By A. S. Buckhurst, L. N. Staniland, and E. B. Watson. (Edward Arnold & Co., 9*s.*)

Vitamins. A Critical Survey of the Theory of Accessory Food Factors. By Ragnar Berg. Translated by Eden and Cedar Paul. (George Allen & Unwin, Ltd., 18*s.*)

Mnemic Psychology. By Richard Semon. Translated by Bella Duffy. (George Allen & Unwin, Ltd., 14*s.*)

Chemische Grundbegriffe. By A. Benrath. Harrap's Bilingual Series. (G. G. Harrap & Co., Ltd., 2*s.*)

Radio-activity. By K. Fajans. Translated by T. S. Wheeler and W. G. King. (Methuen & Co., 8*s.* 6*d.*)

The Structure of the Atom. A Supplementary Chapter to *Modern Electrical Theory.* By N. R. Campbell, Sc.D. (Cambridge University Press, 10*s.*)

Flying. By Major W. T. Blake. (George Allen & Unwin, 6*s.*)

From Determinant to Tensor. By W. F. Sheppard, Sc.D., LL.M., Formerly Fellow of Trinity College, Cambridge. (Clarendon Press, 8*s.* 6*d.*)

Essays of a Biologist. By Julian Huxley. (Chatto & Windus, 7*s.* 6*d.*)

Popular Fallacies Explained and Corrected. 3rd Edition. By A. G. E. Ackermann. (Old Westminster Press, 12*s.* 6*d.*)

Recent Developments in Atomic Theory. By Leo Graetz. (Methuen & Co., 9*s.*)

Principles and Practice of Wireless Transmission. By G. Parr. (Messrs. Benn Brothers, 5*s.*)

Wireless Telephony. A simplified explanation. By R. D. BANGAY. (The Wireless Press, Ltd.)

Time and Weather by Wireless. By W. G. W. MITCHELL. (The Wireless Press, Ltd.)

Diary 1924. (The Wireless Press, Ltd.)

The Principle of Relativity. By ALBERT EINSTEIN, H. A. LORENTZ, H. MINKOWSKI, A. SOMMERFELD, and H. WEYL. Translated by G. B. JEFFERY, D.Sc., and W. PERRETT, Ph.D. (Methuen & Co., 12*s.* 6*d.*)

Eclipses of the Sun. By S. A. MITCHELL. (Humphrey Milford, 17*s.*)

THE ARTS AND HUMANITIES, ETC.

From Immigrant to Inventor. By MICHAEL PUPIN. (Charles Scribner's Sons, 18*s.*)

The Philosophy of Proof. By the late J. R. GULSON. (George Routledge.)

Burns's Income-tax Guide. Fifth Edition. (W. Green & Son, Ltd., 2*s.* 6*d.*)

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A Nuer-English Vocabulary. Compiled by the late C. H. STIGAND. (Cambridge University Press, 2*s.* 6*d.*)

The Legacy of Rome. Essays edited by CYRIL BAILEY. With an Introduction by the RIGHT HON. H. H. ASQUITH. (Oxford : Clarendon Press, 8*s.* 6*d.*)

The Pronunciation of Russian. By PROFESSORS M. V. TROFIMOV and DANIEL JONES. (Cambridge University Press, 6*s.*)

Psychology and Primitive Culture. By F. C. BARTLETT. M.A. (Cambridge University Press, 8*s.* 6*d.*)

Aberrations of Life. By JAMES CLARK MCKERROW, M.B. (Longmans, Green & Co., 6*s.*)

Voices from Another World. The Waking Dreams and Metaphysical Phantasies of a Non-Spiritualist. Edited by F. GURTIS. Authorised translation by L. A. CLARKE. (George Allen & Unwin, Ltd., 8*s.* 6*d.*)

My Commonplace Book. By J. T. HASKETT. 4th Edition, revised and enlarged. (Macmillan & Co., Ltd., 12*s.* 6*d.*)

Friedrich Hölderlin and the German Neo-Hellenic Movement. Part I. By MARSHALL MONTGOMERY, M.A., B.Litt. (Humphrey Milford, 10*s.* 6*d.*)

Correspondence

ANCIENT MAN IN BRITAIN

To the Editor of DISCOVERY

SIR,

In his rambling remarks regarding my book *Ancient Man in Britain* Mr. Fallaize adopts a tone which may be regarded by some as proof of critical acumen. He would have your readers believe that although I have collected a great mass of important evidence, I am not capable of making effective use of it, being a somewhat irresponsible " extremist." My chief fault appears to be that I refuse to apply to anthropology the hazardous theory of spontaneous generation. In my opinion one must either accept this theory or reject it. There is no " half-way house "—no fence on which one can sit. One must be perfectly frank and honest and have the courage of one's opinions. Mr. Fallaize refers respectfully to the late Dr. W. H. R. Rivers and to Professor Elliot Smith, both of whom have rejected the theory of the spontaneous generation of the same complexes in different parts of the world ; but, in dealing with me, he attempts to ridicule a view which, as it happens, met with the approval of Dr. Rivers. Mr. Fallaize says I identify " a goddess of the Hebrides with a goddess of Egypt through a shell and milk cult, but," as he puts it, " to point out an analogy is not necessarily to prove a connection." What, then, is proved ? This tree goddess could not have possibly had spontaneous generation in the treeless Outer Hebrides. She has quite evidently been imported, and when we find that she is closely associated with a group of complex beliefs and customs similar to those connected with the cult of the fig-tree in Greece, one is not necessarily an extremist if one favours the view that she was imported from the Continent. Those who pretend to know much about the greatest of all mysteries, the working of the human mind, may think it " natural " that the ancient Hebrideans should have associated sea-shells with milk and milk with a tree, and shells and milk with certain precious and semi-precious stones. But there is really nothing " natural " about these arbitrary associations. The so-called " analogy " remains to be accounted for. It has a history. When we find that owing to a set of fortuitous circumstances in ancient Egypt, the goddess Hathor was associated with sea-shells, trees, the sky, a domesticated animal, and certain precious and semi-precious stones, one expects to find, if there is anything in the theory of spontaneous generation favoured by Mr. Fallaize, that a similar set of fortuitous circumstances brought into existence in the Outer Hebrides a complex deity similar to the Egyptian Hathor. If some of your readers are prepared to admit the possibility that the ancient Hebrideans had precisely the same experiences as the ancient Egyptians, it would be as well to remind them that the same tree-shell-and-milk beliefs are found in India and elsewhere in Asia, and that it is therefore necessary to accept the view, apparently favoured by Mr. Fallaize, in dealing with India and China as well as the Outer Hebrides. Having done so, I can smile if I am still called an " extremist." Mr. Fallaize even goes the length of alleging that I do not " appear to have digested " my " material thoroughly." Perhaps, after all, it is better to have something left to digest than to have merely an empty stomach.

Yours, etc.,

DONALD A. MACKENZIE.

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THE RECENTLY FOUND RHODESIAN SKULL

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